KENNEBEC RIVER BASIN
Waterville, Maine

RESERVOIR DAM
ME 00472

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
Waltham, Massachusetts 02154

SEPTEMBER 1981

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ME 00472	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS	5. TYPE OF REPORT & PERIOD COVERED: INSPECTION REPORT
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254	12. REPORT DATE: September 1981 13. NUMBER OF PAGES: 55
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,
Kennebec River Basin
Waterville Maine
Unnamed(Tributary to Kennebec River)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is a small earthfill, concrete core dam located in central Maine about 2 miles north of Waterville. The dam is 735 ft. long and 27 ft. high. The visual inspection showed that the dam and its aputenant structures are in good condition. It is small in size with a high hazard classification. Remedial measure include routine general maintenance to keep the vegetation trimmed among a few others.

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DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED

SEP 30 1981

Honorable Joseph E. Brennan
Governor of the State of Maine
State Capitol
Augusta, Maine 04330

Dear Governor Brennan:

Inclosed is a copy of the Reservoir Dam (ME-00472) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important.

Copies of this report have been forwarded to the Department of Agriculture and to the owner, Kennebec Water District. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Agriculture for your cooperation in in this program.

Sincerely,

WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Acting, Division Engineer

Incl
As stated

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.	:	ME 00472
Name of Dam	:	Reservoir Dam
Town	:	Waterville, ME.
County & State	:	Kennebec & Somerset Counties, Maine
Stream	:	Unnamed (Tributary to Kennebec River)
Date of Inspection	:	November 16, 1979

BRIEF ASSESSMENT

Reservoir Dam is a small earthfill, concrete core dam located in central Maine about two miles north of Waterville. The dam was built to supplement the water supply of the Kennebec Water District. It is essentially a pumped storage project with all of the storage (with the exception of direct precipitation) being pumped into the reservoir from China Lake about 10 miles away. The original structure was built in 1918 but it was enlarged in 1951 so as to double the reservoir storage capacity. The Kennebec Water District owns the dam. They also maintain and monitor the project on a regular basis. The project includes the main dam which is 735 feet long and 27 feet high, a dike along the upper reaches of the reservoir, and a runoff diversion ditch around the perimeter of the project.

The visual inspection showed that the dam and its apurtenant structures are in good condition. With a maximum storage capacity of 156 acre-feet and height of 27 feet it is classified as a small dam. Results from the dam breach analysis determined that the structure should be classified as a high hazard potential because more than a few lives would be threatened in the event of a dam breach.

A test flood was estimated for the Reservoir Dam using the "Preliminary Guidance for Estimating Maximum Probable Discharges in Phase I Safety Investigations", New England Division Corps of Engineers, March 1978. It was assumed that the dike system surrounding the project would prevent any runoff from entering the reservoir during a PMF event. Therefore, only direct precipitation was considered during a Probable Maximum Precipitation (PMP) storm. This resulted in the water level being increased by 1.6 feet to elevation 328.6. This increase when added to the normal water level elevation of 327 would remain below the crest of the dam at Elevation 330 but it would exceed the top of the perimeter dike at Elevation 328.

No urgent or emergency actions are required for Reservoir Dam based on this inspection. Remedial measures include routine general maintenance to keep the vegetation trimmed, monitoring the project during periods of intense rainfall, establishing a monthly visual inspection program, and developing a downstream warning system.

J.E. Giles, Jr., P.E.
Project Manager
Massachusetts Registration No. 1643

This Phase I Inspection Report on **Reservoir Dam (ME-00472)** has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

Aramast Mahtesian

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joe Finegan

JOSEPH W. FINEGAN, JR., CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservior was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project compliance with OSHA rules and regulations is also excluded.

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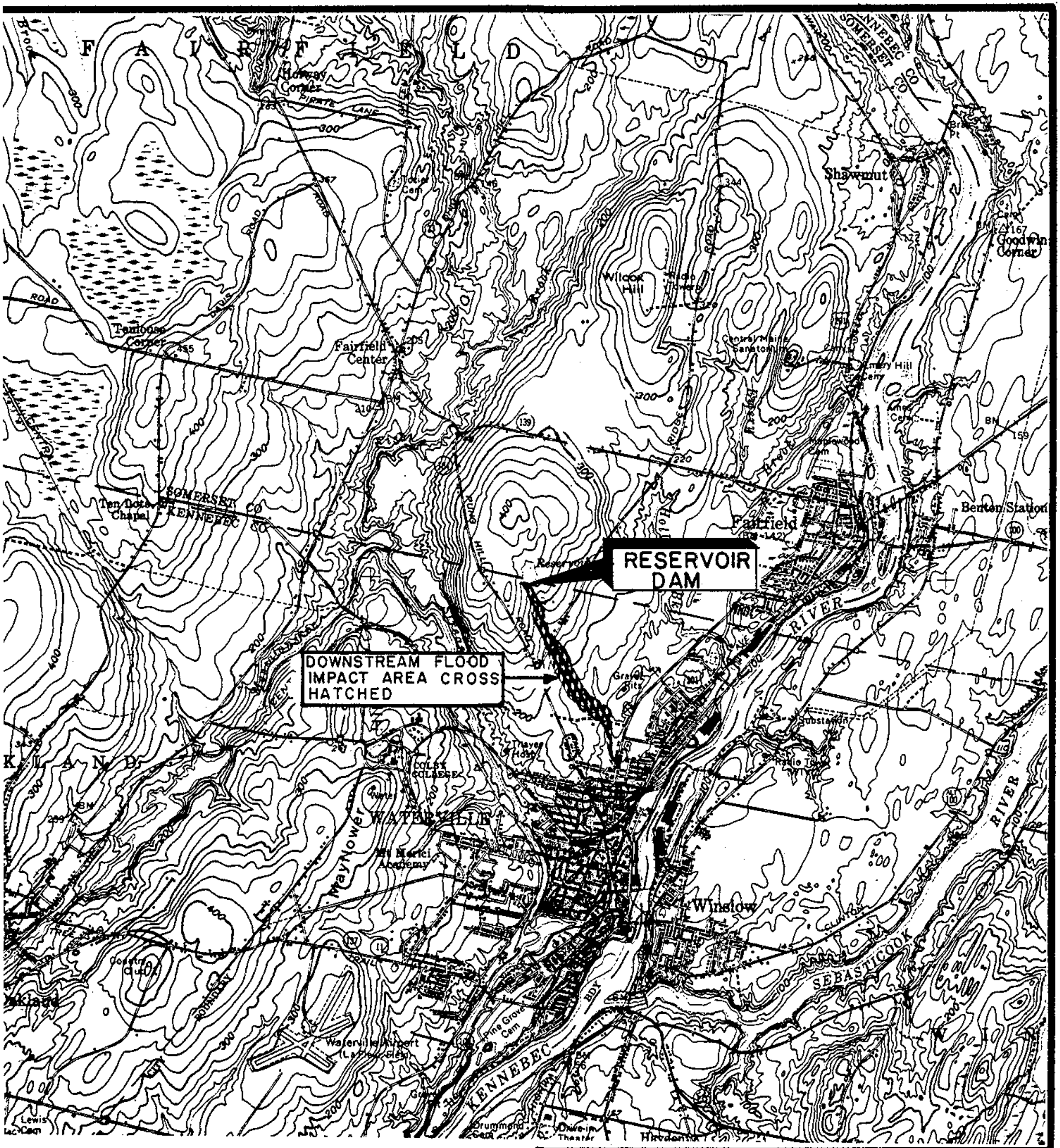
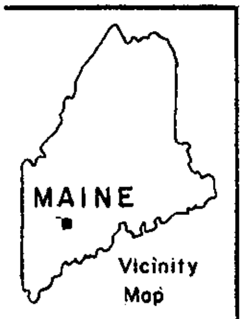
RESERVOIR DAM

View From Right Abutment



FROM USGS WATERVILLE, ME.
15MIN. QUADRANGLE MAP



1 1/2 0 Miles 1

SCALE: 1"=1 MILE

RESERVOIR DAM LOCATION MAP

U.S. ARMY CORPS OF ENGINEERS
PHASE I INSPECTION PROGRAM

MAIN

DATE SEPT. 1981

CLIENT	JOB	PLATE
1345	72	

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

RESERVOIR DAM
KENNEBEC AND SOMERSET COUNTIES, MAINE

SECTION I

PROJECT INFORMATION

1.1 General

a. Authority - Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Chas. T. Main, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Maine. Authorization and notice to proceed were issued to Chas. T. Main, Inc. under a letter of November 6, 1979 from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW 33-80-C-0011 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) The purposes of the inspection program are: To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the states to initiate effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

c. Scope of Inspection Program - The scope of this Phase I inspection report includes:

(1) Gathering, reviewing and presenting all available data as can be obtained from the owners, previous owners, the state and other associated parties.

(2) A field inspection of the facility detailing the visual condition of the dam, embankments and appurtenant structures.

(3) Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.

(4) An assessment of the condition of the facility and corrective measures required.

It should be noted that this report does not pass judgment on the safety or stability of the dam other than on a visual basis. The inspection is to identify those features of the dam which need corrective action and/or further study.

1.2 Description of Project

a. Location - Reservoir Dam is located on the Somerset and Kennebec County Line on an unnamed stream, approximately 1.75 miles above the Kennebec River and two miles north of Waterville. The dam location is included on U.S.G.S. 15 minute series Quadrangle, Waterville, Maine with approximate coordinates of N44°35'0", W69°38'40".

b. Description of Dam and Appurtenances - The project consists of three main features; an earthfill concrete core dam, an earthfill dike, and a runoff diversion ditch. The dam is approximately 735 feet long, 27 feet high, and 12 feet wide at the crest (Elev. 330 NGVD) with upstream and downstream slopes of 1.5 H:1V. The reinforced concrete core wall is 16 inches thick with a 3' x 3' footing that rests on a rock foundation. The top of the wall is five feet lower than the crest of the dam. The upstream face of the dam is protected with rip-rap and the downstream face has a heavy grass cover with a drainage ditch running along the toe.

The earthfill dike extends around the reservoir adjoining the dam at both abutments. It was installed in 1951 to double the storage capacity of the reservoir. The height of the dike varies but the crest is at constant Elevation 328 NGVD. The embankment slope is 2:1 on the reservoir side with a rip-rap cover and 3:1 on the dry side which has a well established grass cover.

Running completely around the project is a runoff diversion ditch. The purpose of this ditch is to prevent any surface run-off from entering and contaminating the reservoir supply.

Two inlet lines, one 24" and one 20" diameter pipes supply water to the reservoir. Two outlet lines, one 16" and one 12" diameter pipes carry the discharge as needed. A 14" line installed when the original dam construction took place in 1918 was closed in 1951. The gate valves on both lines are normally left open to maintain the water pressure in the system and to facilitate water supply operations. The flow within these pipelines, whether filling or emptying the reservoir, is controlled by the Kennebec Water District through its pump house controls located 180 feet downstream from the dam. The source of supply for the reservoir is China Lake located 10 miles southeast of the dam with a drainage area of 36 square miles.

A 14" diameter open pipe serves as an overflow outlet with Invert Elevation 327 NGVD. It has a small concrete receptacle at the inlet and empties into the drainage ditch at the toe of the dam.

c. Size Classification - The maximum embankment height is approximately 27 feet above the downstream toe and the maximum storage is 145 acre-feet at the crest of the dike. This classifies the structure as a small dam (less than 1000 acre feet) in accordance with the Corps of Engineers Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification - This facility is classified as a high hazard potential dam based on the potential for loss of more than a few lives in the event of a dam failure in several occupied dwellings downstream of the dam.

e. Ownership - The dam and associated works are owned by the Kennebec Water District.

f. Operators - The project is operated and maintained by the Kennebec Water District. The District Superintendent is Mr. Theodore Rohman in Waterville, Telephone (207) 872-2763.

g. Purpose of Dam - Reservoir Dam was constructed to supply a secondary water supply source for the Kennebec Water District. The reservoir is entirely contained; surface runoff is diverted around it. The reservoir is supplied through a pipeline distribution network from China Lake.

h. Design and Construction History - The original dam was built in 1918 by the firm of Mr. James H. Kerr of Rumford, Maine. It was designed by Metcalf and Eddy Consulting Engineers from Boston. In 1951, the dam was enlarged and the dike was added so as to double the storage capacity. This work was performed by A. P. Wyman, Inc. of Waterville, Maine, with the engineering supervised by Mr. J. Elliot

Hale. Then in 1978, some minor revisions were performed on the project when the gunite facing was replaced by rip-rap.

i. Normal Operating Procedures - Water is pumped from the China Lake pipe line into the Water Districts distribution pipes, and if the rate of pumping exceeds the consumption at the moment, the excess flows into the reservoir; conversely, if the consumption exceeds the pumping rate, water is drawn from the reservoir to make up the difference. The reservoir thus serves as an equalizer, and assists in the maintenance of a uniform pressure in the pipes. The water level at the reservoir is monitored and recorded on a continuous weekly chart. Normal operating level is between Elevations 327 and 325.

1.3 Pertinent Data

a. Drainage Area - Reservoir Dam controls a drainage area of 0.25 square miles. Runoff from the upstream drainage area is diverted around the reservoir. Thus, runoff drainage is not considered when evaluating the hydrologic conditions of this dam.

b. Discharge at Damsite

(1) Outlet Works - The storage is discharged through a 24" diameter and 14" diameter pipe controlled by the pumphouse equipment at the downstream end. The invert elevation of the 24" is 316 and of the 14" is 302. Also, a 14" diameter open overflow pipe is at invert Elevation 327.

(2) Maximum known flood - Unavailable in existing data.

c. Elevations (feet above NGVD)

(1) Streambed at toe of dam	303
(2) Bottom of cutoff	295
(3) Maximum tailwater	Not available
(4) Normal Pool	327
(5) Full flood control pool	Not applicable
(6) Spillway crest (overflow pipe)	327
(7) Design surcharge (Original Design)	Not available
(8) Top of upstream dike	328
(9) Top of dam	330

	(10) Test flood surcharge	328.6	
d.	<u>Reservoir</u> (Length in feet)		
	(1) Normal pool @ Elev. 327	230	
	(2) Flood control pool	Not applicable	
	(3) Spillway crest pool	230	
	(4) Top of dam	230	
	(5) Test flood pool	230	
e.	<u>Storage</u> (acre-feet)		
	(1) Normal Pool	128	
	(2) Flood control pool	Not applicable	
	(3) Spillway crest pool	128	
	(4) Top of dike	145	
	(5) Test flood pool	156	
f.	<u>Reservoir Surface</u> (acres)		
	(1) Normal Pool	11.1	
	(2) Flood-control pool	Not applicable	
	(3) Spillway crest	11.1	
	(4) Test flood pool	11.4	
	(5) Top of dam	12.0	
g.	<u>Dam and Dike</u>	<u>Dam</u>	<u>Dike</u>
	(1) Type	Earthfill concrete core	Earthfill
	(2) Length	735 feet	1,535 ft.
	(3) Height	27 feet	Varies
	(4) Top Width	12 feet	12 ft.

		DAM	DIKE
(5)	Side Slopes	Upstream 1.5:1 Downstream 1.5:1	Upstream 2.0:1 Downstream 3.0:1
(6)	Zoning	None	None
(7)	Impervious Core	Concrete	None
(8)	Cutoff	Concrete	None
(9)	Grout curtain	None	None
(10)	Other	Rip-rap face	Rip-rap face

h. Diversion and Regulating Tunnel - None

i. Principal Outlet Works

(1) Invert - 327' NGVD

(2) Size - 14" Dia.

(3) Description - Overflow control

(4) Control Mechanism - Open - No valves

(5) Other - None

j. Regulating Outlets

(1) i. Invert - 302' NGVD
ii. Size - 20" Dia.
iii. Description - Inlet & Outlet Supply Pipeline
iv. Control Mechanism - Pumps located downstream govern flow; check valve in valve chamber on dam.

(2) i. Invert - 316' NGVD
ii. Size - 24" Dia.
iii. Description - Inlet & Outlet Supply Pipeline
iv. Control Mechanism - Pumps located downstream govern flow; check valve located 180' downstream.

SECTION 2

ENGINEERING DATA

2.1 Design

Metcalf & Eddy Consulting Engineers from Boston Massachusetts, were the engineers responsible for designing the original Reservoir Dam structure. Three of their original drawings were obtained and are included in Appendix B. Also, the report from Metcalf & Eddy to the Trustees of the Kennebec Water District; Re., "Necessity and Approximate Cost of a New Distributing Reservoir", August 3, 1916, was reviewed in preparing this report. Two additional drawings showing the 1951 revisions were obtained and are in Appendix B. The Contract and Specifications for "Improvements to Reservoir for Kennebec Water District", March 1, 1951, were reviewed. Also, the Trustees' Statements from 1917, 1919 and 1951 were received from the Kennebec Water District. Unfortunately, design calculations from neither the 1918 nor 1951 construction were available in preparing this report.

The general design of the dam is an earthfill structure with a concrete core wall down to bedrock. The 16" thick reinforced wall has a 3' x 3' concrete base which sets on a rock foundation. The embankment slopes were originally 2.5:1 and 2:1 on the upstream and downstream slopes respectively but these were changed in 1951 such that both slopes are now 1.5:1.

2.2 Construction

There are no actual records of the original or revised construction other than the report from the Kennebec Water District. The earthfill was taken from the reservoir area which, according to Metcalf and Eddy, was a clayey hardpan, extremely hard and laid in layers with the "best selected material" forming the upstream embankment and the "second grade material" forming the downstream embankment. The original dam was built by the firm of Mr. James H. Kerr from Rumford, Maine. The 1951 changes were performed by A. P. Wyman, Inc. of Waterville, Maine.

2.3 Operation

The daily level of the reservoir is monitored and recorded by the Kennebec Water District. The level of the reservoir is maintained between Elevations 325 and 327 under normal use. The water level is mechanically controlled by the pumps and valves within the Water District's distribution network. The pipeline pressure at the pumping station downstream from the dam is approximately 110 p.s.i. due to the pressure head from the reservoir. During low usage when it is not economical to run the systems large pumps, the reservoir becomes the major source of water supply, taking advantage of its pressure head for distribution.

2.4 Evaluation

a. Availability: All of the engineering data acquired was received from the Kennebec Water District. This includes the drawings, reports, and miscellaneous material. All of the drawings received are included in Appendix B.

b. Adequacy: The limited amount of engineering data did not allow for a definitive review. Evaluation must be based on visual inspection, past performance history, and engineering judgment.

c. Validity: The field inspection indicated that the external features of the dam and appurtenances substantially agree with those shown on the available drawings.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General - The field inspection was conducted by Mr. L. Seward and Mr. J. Jonas of Chas. T. Main, Inc. on 16 November 1979 and J. E. Giles, Jr. on March 10, 1981. On the dates of inspection, the Reservoir Dam was in good condition. General maintenance of the project is necessary but no urgent or emergency actions are required at this time.

b. Dam

(1) Crest - The embankment crest was true to line with no apparent dips, sags, cracks or other evidence of distress (Photo 1 & Overview). The crest has a well established grass cover with no signs of trespassing.

(2) Upstream slopes - The upstream face was in very good condition with an undamaged rip-rap cover (Photos 1, 2 3 & Overview).

(3) Downstream slope - The downstream slope is dry with a heavy, well established grass cover (Photo 4). The slope showed no signs of lateral movement, erosion, sagging, or slides. No seepage was observed. The grass and weeds appeared overgrown and uncut but in general the slope was in good condition.

(4) Downstream toe - No boils or seeps were observed. The drainage ditch running along the toe contained a small amount of running water from upstream of the reservoir. The flow was approximately ten gals per minute. It appeared in good condition although somewhat overgrown with cattails, brambles, and other weeds.

(5) Underdrain system - The dam has no underdrain system.

(6) Instrumentation - The only instrument at the project is the water level device which was not observed during the inspection. A copy of a weekly chart which records the water level was made available and is included in Appendix B.

c. Appurtenent Structures

(1) Dike - The dike surrounding the upper part of the reservoir and adjoining the dam abutments was in good condition. It has no apparent dips, sags, or other evidence of distress along the crest. There was no evidence of seepage. The crest and dry-side slopes did have a well-established grass cover. The embankment had a very good rip-rap cover along the entire length.

(2) Intercepting ditch - The intercepting or diversion ditch completely surrounds the project. At the time of inspection it had a small amount of water flowing through it. Most of this water flowed along the western side of the reservoir with only a trickle flowing along the eastern side. The ditch appeared to be functioning properly, that is, diverting the surface runoff around the reservoir.

(3) Inlet and outlet works - Because both supply and outlet lines were buried and their inlets and outlets submerged, these were not able to be inspected. (See Section 7) The housing for the valve control for the 14" abandoned pipeline is unused with some rubbish accumulated at the bottom.

d. Reservoir Area

The reservoir looked very clean with no irregularities observed. On the northwest upstream end of the reservoir, outside of the dike but inside the diversion ditch, a small pool of relatively stagnant water was observed. It appeared that this shallow pool would occassionally spill over the dike (without damage) into the reservoir. Probably the result of rainwater, this pool is not a serious problem at present. (See Section 7)

e. Downstream Channel

There is a well-defined downstream channel below the dam with only a small flow consisting of the discharge from the diversion ditch around the project. There were no obstructions noted.

3.2 Evaluation

The dam, dike, reservoir, and diversion channel are all in good condition. The only points which should be checked are operability of the controls, the overgrowth of grass and weeds on the downstream slope and around the drainage ditch, and the pool of stagnant water at the northwest corner of the project.

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General: Reservoir Dam is used exclusively for water supply. Inflow and outflow are based on water supply demand within the system. The fluctuation of the reservoir level is about two feet during normal operations with the maximum level controlled by an overflow pipe at Elevation 327 NGVD.

b. Warning System: No warning system or emergency evacuation plans are in effect for this project. (See Section 7)

4.2 Maintenance Procedures

a. General: The dam is maintained by the Kennebec Water District. The site is visited daily by members of the Kennebec Water District staff. Repairs and general maintenance are performed as required.

b. Operating Facilities: At the project site, there are no manual operations necessary during normal use. The check valves on both supply lines are left open at all times and the reservoir level is monitored by a recording device.

4.3 Evaluation

The operational and maintenance procedures required at the Reservoir Dam are minimal. There does appear to be a lack of general slope maintenance, that is, keeping the grass and weeds trimmed.

SECTION 5

EVALUATION OF HYDROLOGIC AND HYDRAULIC FEATURES

5.1 General - The runoff from the watershed area above Reservoir Dam is diverted around the reservoir. The dam is located approximately two miles above the town of Waterville Maine. The catchment area of the reservoir is 0.25 square miles. For the Test Flood Analysis the 24 hour Probable Maximum Precipitation (PMP) of 19 inches was used. This results in the dike being overtopped by about six inches.

5.2 Design Data - The dam embankment is approximately 735 feet long and 27 feet high with crest at Elevation 330 NGVD. The embankment has upstream and downstream slopes of 1.5:1. The capacity of the reservoir at various elevations was taken from a table used by the project operators.

5.3 Experience Data - No past hydrology data was available.

5.4 Test Flood Analysis - Because the reservoir is not subjected to runoff from the watershed area above it, the Test Flood Analaysis was performed using only direct precipitation into the reservoir during a PMP event. The PMP for this portion of Maine is assumed to be 19 inches. The starting elevation of the reservoir prior to the PMP is taken as Elevation 327, the invert of the overflow pipe. The top of the dike is at Elevation 328 which means that approximately seven inches of water will overtop the dike. Of course, this is assuming that the overflow pipe is not passing any water which is not altogether realistic. Because of the small area of the reservoir together with the 12 inches of freeboard at the pool's maximum operating level, Reservoir Dam is expected to adequately control the Test Flood. However, it should be noted, the assumption that all of the upstream runoff will be diverted around the reservoir because of the dike and diversion channel may not be true. It is possible that some of the runoff will overtop the dike and enter the reservoir but a flood analysis to take this into account is beyond the scope of this report.

5.5 Dam Failure Analysis - The maximum water surface elevation of 328.6 feet and 156 acre-feet is considered in dam breach analysis. The impact of failure of the dam was assessed using the "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs" prepared by the Corps of Engineers. The breach width was selected to be 35 percent of the length of the dam at mid-height 257 feet. The downstream discharge from the breach of the dam was estimated to be about 56,000 cfs. This discharge was routed downstream. At the northern end of Waterville, the flood surcharge will enter the residential section with an initial height of 4.4 feet and volume of 4000 cfs. It is felt that a wave of this size would cause considerable damage once it reached the town, especially if its flow were restricted when passing through the residential area. The downstream flood impact area is outlined on the Location Map. Between the dam and the northern side of Waterville some 9,000 feet downstream (Reach 26), there are no residences or other structures which would be damaged by the dam breach surcharge. When the surcharge reaches the homes in the northern side of Waterville it is expected that serious property damage and loss of more than a few lives would result. For this reason, the dam has been classified as a high hazard potential.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observation

The visual inspections of the Reservoir Dam on November 16, 1979 and March 10, 1981 revealed a sound structure with no evidence of instability. There were no dips, sags, or depressions observed in the embankment.

6.2 Design and Construction Data

Original design and construction data was not available in preparing this report.

6.3 Post Construction Changes

In 1951 the dam was raised five feet and the dike was added. In 1978, the gunite facing was replaced with a rip-rap cover. No other major structural changes were performed to the dam.

6.4 Seismic Stability

The dam is located in Seismic Zone No. 2 and, in accordance with recommended Phase I guidelines, does not warrant seismic analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition - This inspection indicates that Reservoir Dam is in good condition including the dike and diversion ditch.

b. Adequacy of Information - The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data but is based primarily on visual inspection, past performance history and engineering judgment.

c. Urgency - The remedial measures presented below should be inplemented by the Owner within one year of receipt of this Phase I Inspection Report.

7.2 Recommendations

a. Drain pool outside dike at north west corner of reservoir by connecting to the drainage ditch.

b. Place shutoff valves inside the reservoir on both the two inlet and two outlet pipe lines.

7.3 Remedial Measures The owner should:

a. Establish a formal downstream warning and evacuation plan to be implemented in the event of an emergency.

b. Establish a system to monitor the project during periods of intense rainfall.

d. Conduct a technical investigation of the project every two years.

e. Obtain and maintain a set of as-built drawings and inspection reports.

f. Periodically trim the grass and remove the weeds on the downstream slope and around the drainage channel.

7.4 Alternatives

There are no practical alternatives to the recommendations of Sections 7.2 and 7.3.

APPENDIX A

FIELD INSPECTION CHECK LIST

INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT Reservoir Dam, Waterville, ME

DATE Nov. 16, 1979

TIME 11:00 A.M.

WEATHER Fair, Windy, 30°F

W.S. ELEV.______ U.S._____ DN.S.

PARTY:

1. Stanley S. Marshall, Civil Engineer
2. Jan N. Jonas, Civil Engineer
3. J. E. Giles, Jr., Project Manager*
4.
5.
6.
7.
8.
9.
10.

PROJECT FEATURE	INSPECTED BY	REMARKS
1. All project features were inspected by each member of the		
2. inspection party.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

*at site March 10, 1981

INSPECTION CHECK LIST

PROJECT Reservoir Dam, Waterville, ME DATE Nov. 16, 1979

PROJECT FEATURE Earthfill Dam-water sply NAME Stanley S. Marshall

DISCIPLINE Hydro NAME Jan N. Jonas

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	330 feet
Current Pool Elevation	327 feet
Maximum Impoundment to Date	40,000,000 gallons (elev. 327)
Surface Cracks	None visible
Pavement Condition	Gravel
Movement or Settlement of Crest	None visible
Lateral Movement	None visible
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Not applicable
Indications of Movement of Structural Items on Slopes	Not applicable
Trespassing on Slopes	None visible
Vegitation on Slopes	Some weeds and grass
Sloughing or Erosion of Slopes or Abutments	None visible
Rock Slope Protection - Riprap Failures	No failures visible
Unusual Movement or Cracking at or near Toes	None visible
Unusual Embankment or Downstream Seepage	None
Piping or Boils	None visible
Foundation Drainage Features	Runoff drainage ditch
Toe Drains	Same
Instrumentation System	None

INSPECTION CHECK LIST

PROJECT Reservoir Dam, Waterville, ME DATE Nov. 16, 1979

PROJECT FEATURE Earthfill NAME Stanley S. Marshall

DISCIPLINE Hydro NAME Jan N. Jonas

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Not applicable - diversion ditch by-passes reservoir
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	
Condition of Concrete	Not visible
Stop Logs and Slots	

INSPECTION CHECK LIST

PROJECT Reservoir Dam Waterville, ME — DATE Nov. 16, 1979

PROJECT FEATURE Earthfill Dam — NAME Stanley S. Marshall

DISCIPLINE Hydro — NAME Jan N. Jonas

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	Valve chamber in dam embankment
General Condition	
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	N/A
Float Wells	N/A
Crane Hoist	N/A
Elevator	N/A
Hydraulic System	N/A
Service Gates	Operability of check valve not known
Emergency Gates	N/A
Lightning Protection System	N/A
Emergency Power System	N/A
Wiring and Lighting System in Gate Chamber	N/A

INSPECTION CHECK LIST

PROJECT Reservoir Dam Waterville, ME DATE Nov. 16, 1979

PROJECT FEATURE Earthfill Dam NAME Stanley S. Marshall

DISCIPLINE Hydro NAME Jan N. Jonas

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	Not visible
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	
DIKE EMBANKMENT	
Crest Elevation	328 feet
Surface Cracks	None
Movement or Settlement of Crest	None
Lateral Movement	None
Vertical Alignment	Good
Horizontal Alignment	Good
Trespassing on Slopes	None
Vegitation on Slopes	Heavily grassed
Sloughing or Erosion	None
Rip-rap Cover	Good
Seepage	None

INSPECTION CHECK LIST

PROJECT Reservoir Dam Waterville, ME

DATE Nov. 16, 1979

PROJECT FEATURE Earthfill Dam

NAME Stanley S. Marshall

DISCIPLINE Hydro

NAME Jan N. Jonas

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	Not applicable
General Condition of Concrete	
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain holes	
Channel	
Loose Rock or Trees Overhanging Channel	
Condition of Discharge Channel	

INSPECTION CHECK LIST

PROJECT Reservoir Dam Waterville, ME — DATE Nov. 16, 1979

PROJECT FEATURE Earthfill Dam — NAME Stanley S. Marshall

DISCIPLINE Hydro — NAME Jan N. Jonas

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Not applicable
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir and Training Walls	None
General Condition of Concrete	
Rust or Staining	
Spalling	
Any Visible Reinforcing	
Any Seepage or Efflorescence	
Drain Holes	
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Channel	N/A
Other Obstructions	None

INSPECTION CHECK LIST

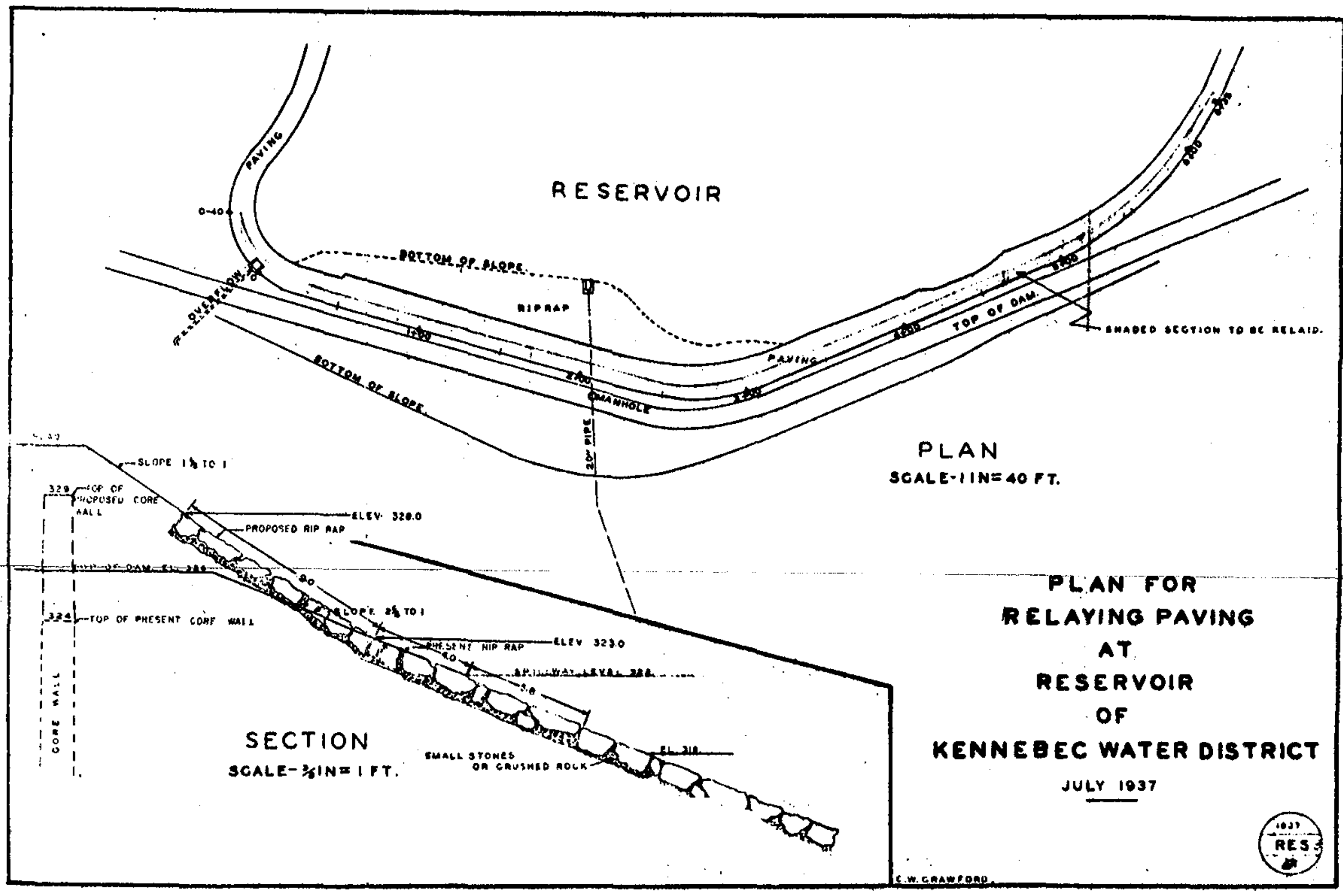
PROJECT Reservoir Dam Waterville, ME	DATE Nov. 16, 1979
PROJECT FEATURE Earthfill Dam	NAME Stanley S. Marshall
DISCIPLINE Hydro	NAME Jan N. Jonas

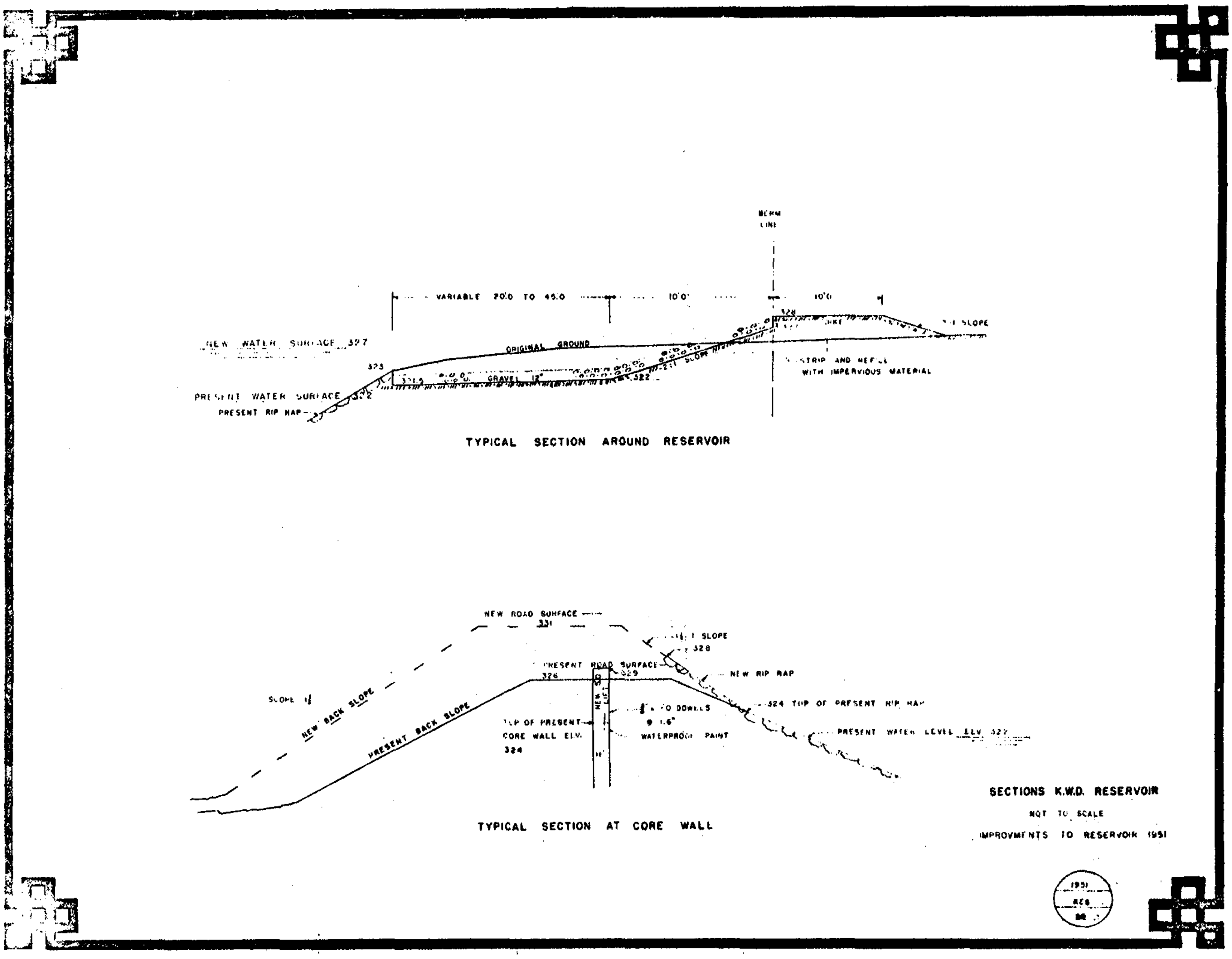
AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure	None
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

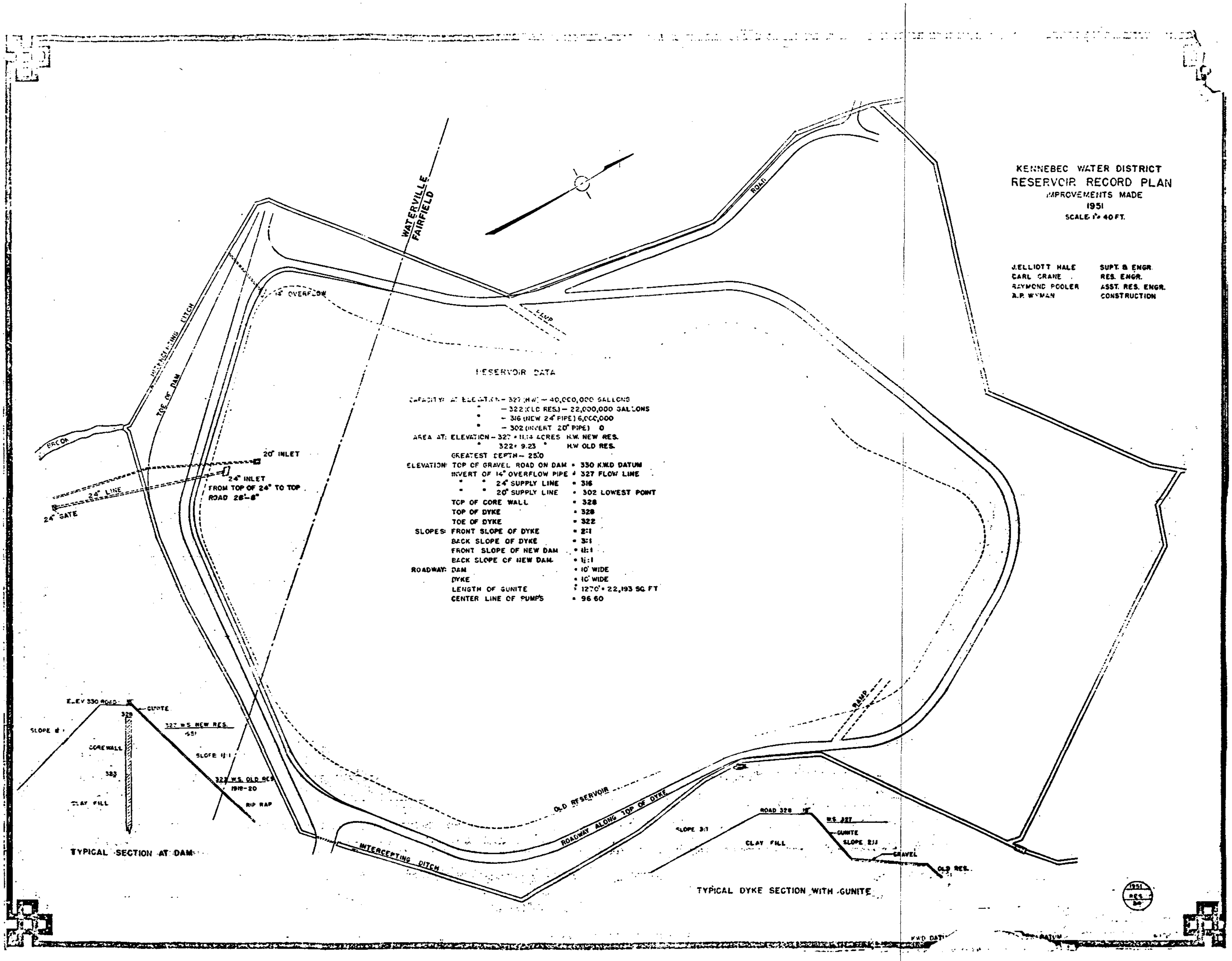
APPENDIX B

ENGINEERING DATA

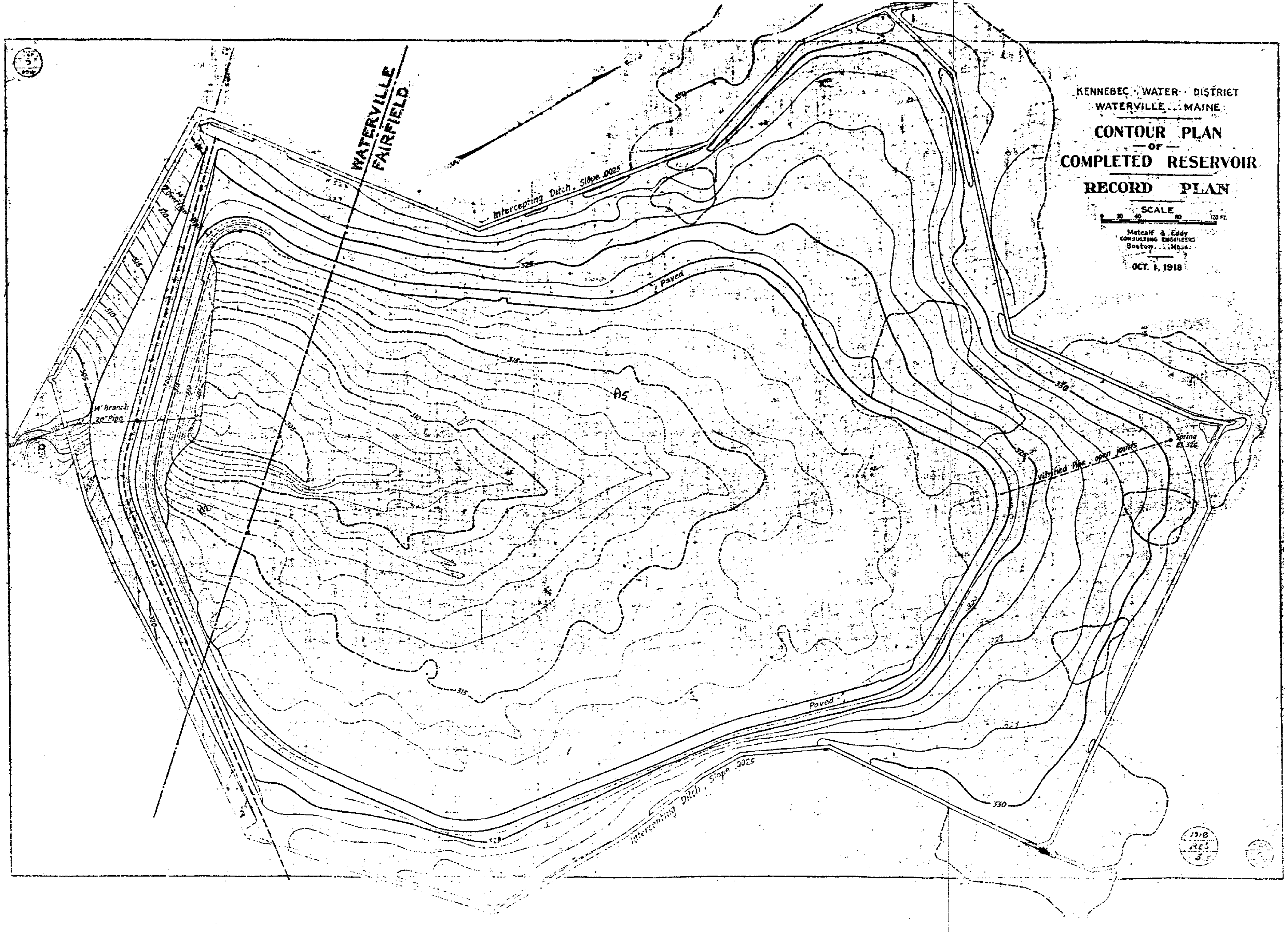
LIST OF ENCLOSED DRAWINGS

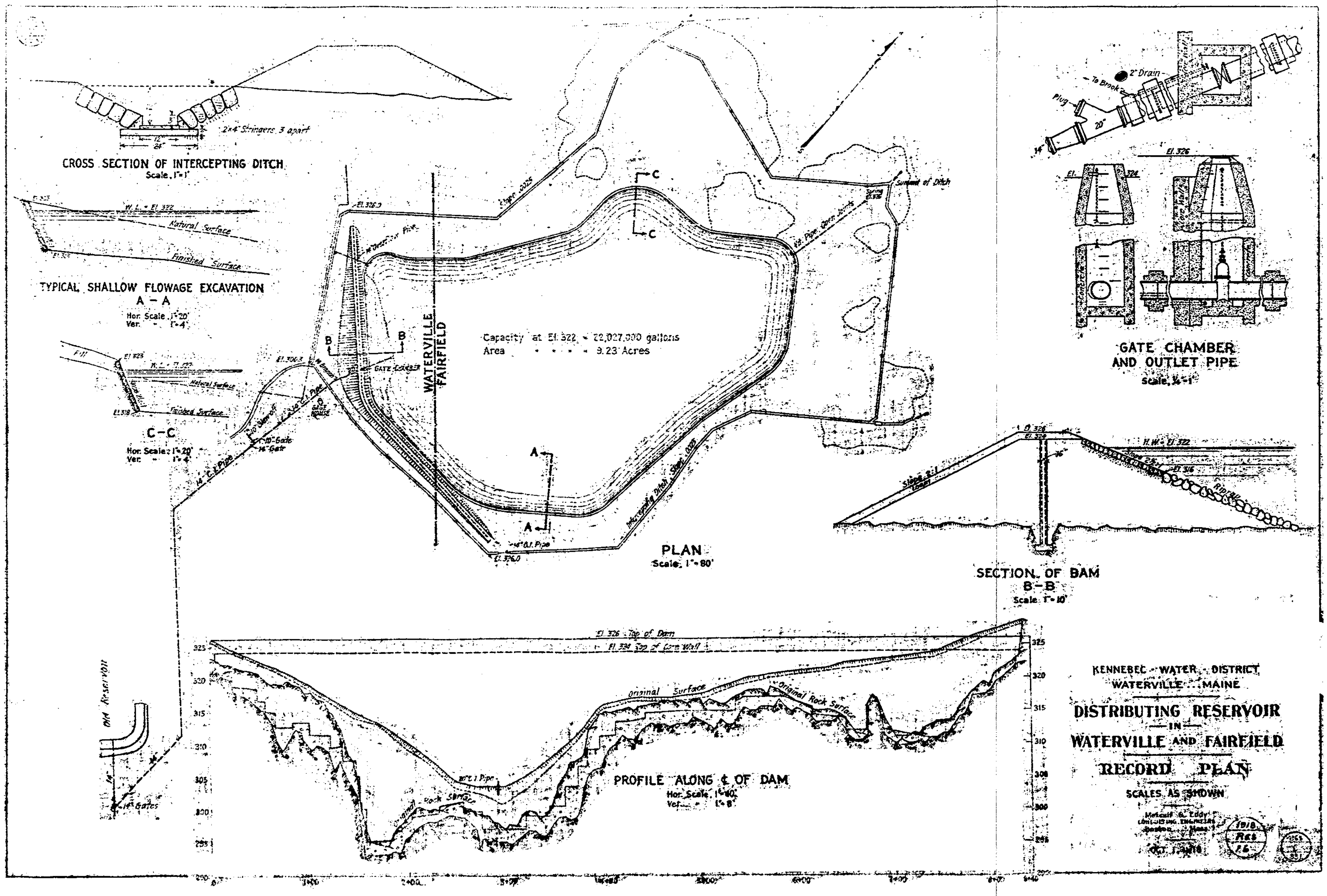

RESERVOIR
BOTTOM OF SLOPE
RIP RAP
PAVING
TOP OF DAM
MANHOLE
20" PIPE
BOTTOM OF SLOPE
SHADED SECTION TO BE RELAID.
PLAN
SCALE-1 IN=40 FT.
SLOPE 1½ TO 1
PROPOSED RIP RAP
ELEV. 328.0
TOP OF PRESENT CORE WALL
SLOPE 2½ TO 1
PRESENT RIP RAP
ELEV 323.0
CORE WALL
SECTION
SCALE-¾ IN=1 FT.
SMALL STONES
OR CRUSHED ROCK
PLAN FOR
RELAYING PAVING
AT
RESERVOIR
OF
KENNEBEC WATER DISTRICT
JULY 1937
RES 3
C.W. CRAWFORD


BERM LINE
VARIABLE 20.0 TO 45.0
10.0
10.0
NEW WATER SURFACE 327
ORIGINAL GROUND
PRESENT WATER SURFACE 322
PRESENT RIP RAP
GRAVEL 12"
STRIP AND REFILL WITH IMPERVIOUS MATERIAL
TYPICAL SECTION AROUND RESERVOIR
NEW ROAD SURFACE
331
PRESENT ROAD SURFACE
326
329
328
NEW RIP RAP
324 TOP OF PRESENT RIP RAP
NEW BACK SLOPE
PRESENT BACK SLOPE
TOP OF PRESENT CORE WALL ELV.
324
WATERPROOF PAINT
PRESENT WATER LEVEL ELV 322
TYPICAL SECTION AT CORE WALL
SECTIONS K.W.D. RESERVOIR
NOT TO SCALE
IMPROVMENTS TO RESERVOIR 1951
1951
RES

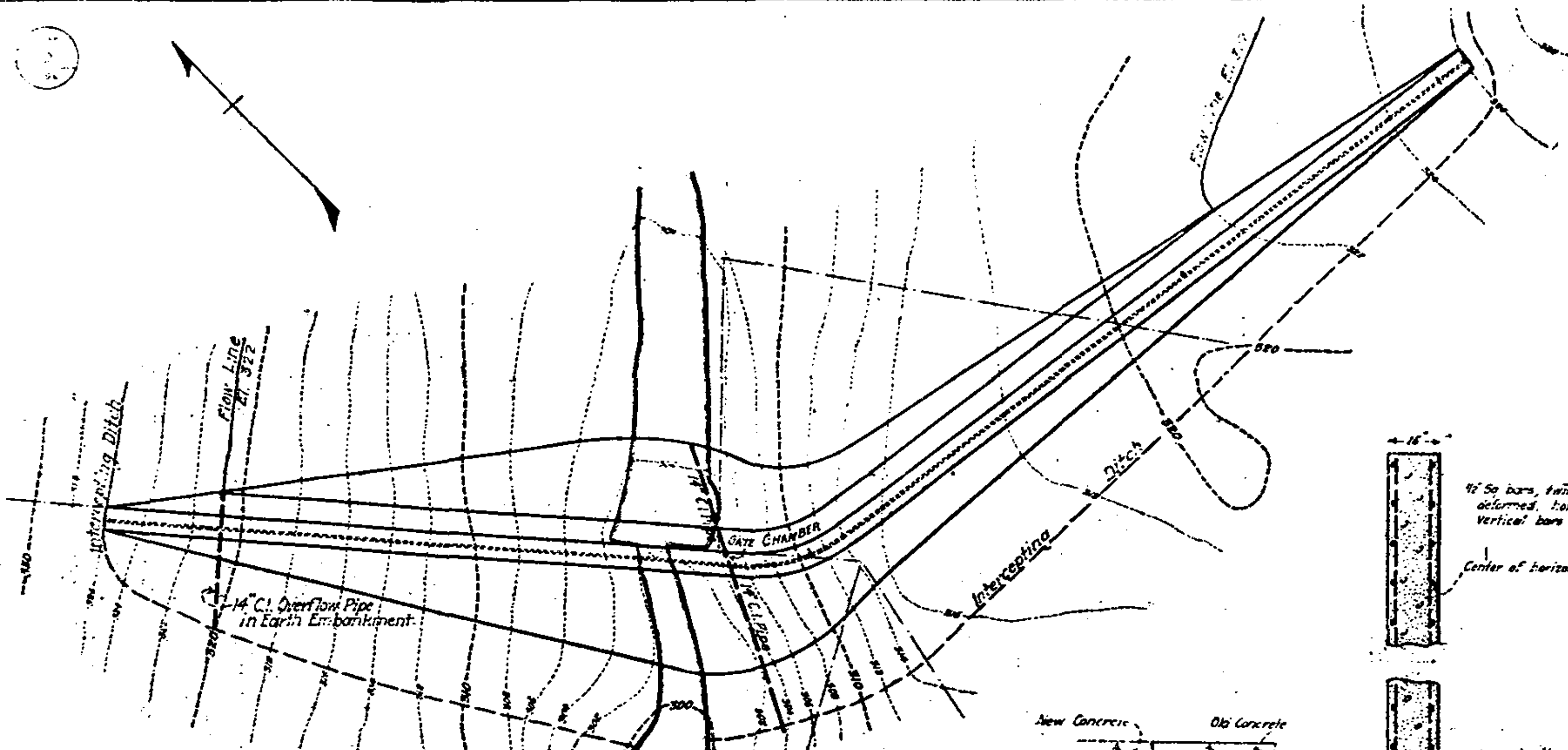


KENNEBEC WATER DISTRICT
RESERVOIR RECORD PLAN
IMPROVEMENTS MADE
1951
SCALE 1" = 40 FT.
J.ELLIOTT HALE SUPT. & ENGR.
CARL CRANE RES. ENGR.
RAYMOND POOLER ASST. RES. ENGR.
A.P. WYMAN CONSTRUCTION
RESERVOIR DATA
CAPACITY: AT ELEVATION – 327 (H.W.) – 40,000,000 GALLONS
" – 322 (OLD RES.) – 22,000,000 GALLONS
" – 316 (NEW 24" PIPE) 6,000,000
" – 302 (INVERT 20" PIPE) 0
AREA AT: ELEVATION – 327 = 11.14 ACRES H.W. NEW RES.
" 322 = 9.23 " H.W. OLD RES.
GREATEST DEPTH – 25.0
ELEVATION: TOP OF GRAVEL ROAD ON DAM = 330 K.W.D DATUM
INVERT OF 14" OVERFLOW PIPE = 327 FLOW LINE
" " 24" SUPPLY LINE = 316
" " 20" SUPPLY LINE = 302 LOWEST POINT
TOP OF CORE WALL = 328
TOP OF DYKE = 328
TOE OF DYKE = 322
SLOPES: FRONT SLOPE OF DYKE = 2:1
BACK SLOPE OF DYKE = 3:1
FRONT SLOPE OF NEW DAM = 1½:1
BACK SLOPE OF NEW DAM = 1½:1
ROADWAY: DAM = 10' WIDE
DYKE = 10' WIDE
LENGTH OF GUNITE = 1270' = 22,193 SQ. FT
CENTER LINE OF PUMPS = 96.60
WATERVILLE
FAIRFIELD
ROAD
RAMP
14" OVERFLOW
TOE OF DAM
20" INLET
24" INLET
FROM TOP OF 24" TO TOP ROAD 26'-6"
24" LINE
24" GATE
OLD RESERVOIR
ROADWAY ALONG TOP OF DYKE
INTERCEPTING DITCH
ELEV 330 ROAD
GUNITE
328
327 W.S. NEW RES. 1951
CORE WALL
SLOPE 1½:1
322 W.S. OLD RES. 1918-20
RIP RAP
CLAY FILL
TYPICAL SECTION AT DAM
ROAD 328
W.S. 327
GUNITE
SLOPE 3:1
SLOPE 2:1
CLAY FILL
GRAVEL
OLD RES.
TYPICAL DYKE SECTION WITH GUNITE

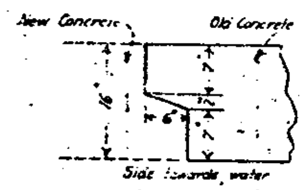

KENNEBEC · WATER · DISTRICT
WATERVILLE ... MAINE
CONTOUR PLAN
— OF —
COMPLETED RESERVOIR
RECORD PLAN
SCALE
0 20 40 80 120 FT.
Metcalf & Eddy
CONSULTING ENGINEERS
Boston ... Mass.
OCT. 1, 1918
WATERVILLE
FAIRFIELD
Intercepting Ditch, Slope .0025
Paved
Vitrified Pipe, open joints
Spring
El. 326
14" Branch
20" Pipe
315
310
305
325
330



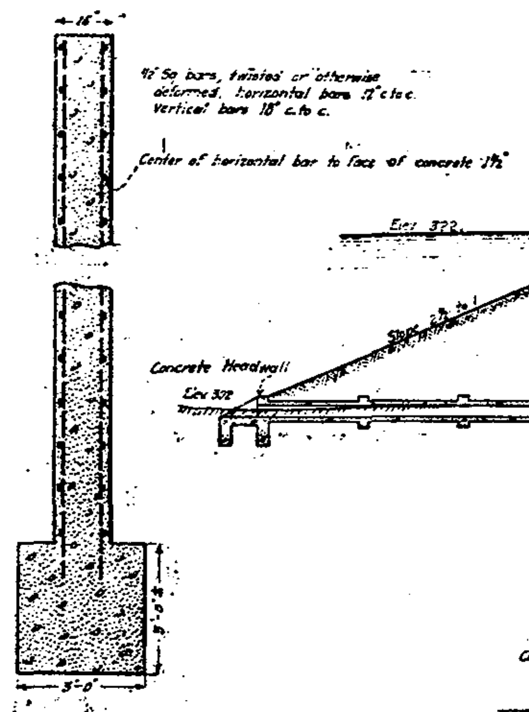
CROSS SECTION OF INTERCEPTING DITCH
Scale, 1"=1'
2"x4" Stringers 3' apart
TYPICAL SHALLOW FLOWAGE EXCAVATION
A – A
Hor. Scale, 1"=20'
Ver. " 1"=4'
W. L. = El. 322
Natural Surface
Finished Surface
C – C
Hor. Scale, 1"=20'
Ver. " 1"=4'
Fill
El. 318
WATERVILLE
FAIRFIELD
Capacity at El. 322 = 22,027,000 gallons
Area = 9.23 Acres
GATE CHAMBER
GATE HOUSE
14" C.I. Pipe
10" Gate
14" Gate
Intercepting Ditch
Summit of Ditch
El. 326.0
PLAN
Scale, 1"=80'
GATE CHAMBER
AND OUTLET PIPE
Scale, ¼"=1'
2" Drain
To Brook
Plug
20"
14"
El. 326
El. 324
SECTION OF DAM
B – B
Scale 1"=10'
H. W. = El. 322
El. 316
Slope 2:1
Riprap
El. 326 Top of Dam
El. 324 Top of Core Wall
Original Surface
Original Rock Surface
PROFILE ALONG ℄ OF DAM
Hor. Scale, 1"=40'
Ver. " 1"=8'
Old Reservoir
14" Gates
KENNEBEC WATER DISTRICT
WATERVILLE MAINE
DISTRIBUTING RESERVOIR
IN
WATERVILLE AND FAIRFIELD
RECORD PLAN
SCALES AS SHOWN
Metcalf & Eddy
Consulting Engineers
Boston, Mass.
OCT. 1, 1918
1918
Res
1-6



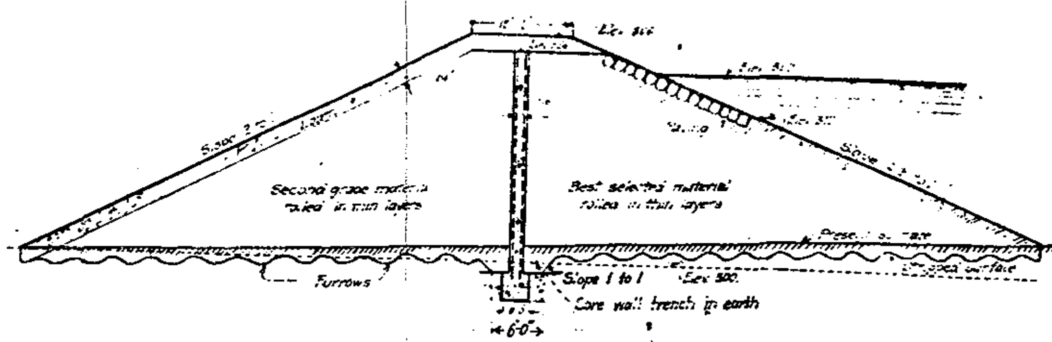
Plan of Dam
Scale, 40 ft. to 1 in.



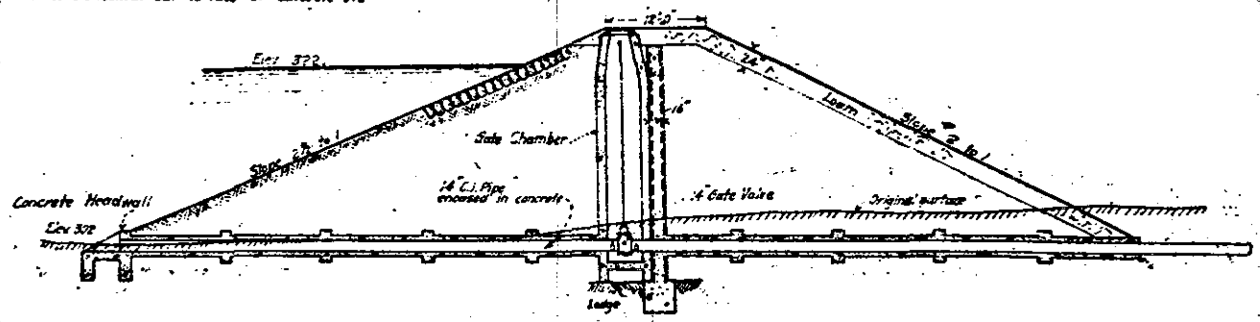
Details of Core Wall Joint
Scale 1 ft. to 1 in.



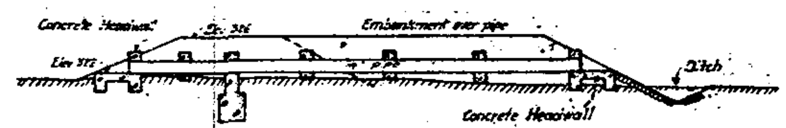
Section of Core Wall
Scale 2 ft. to 1 in.



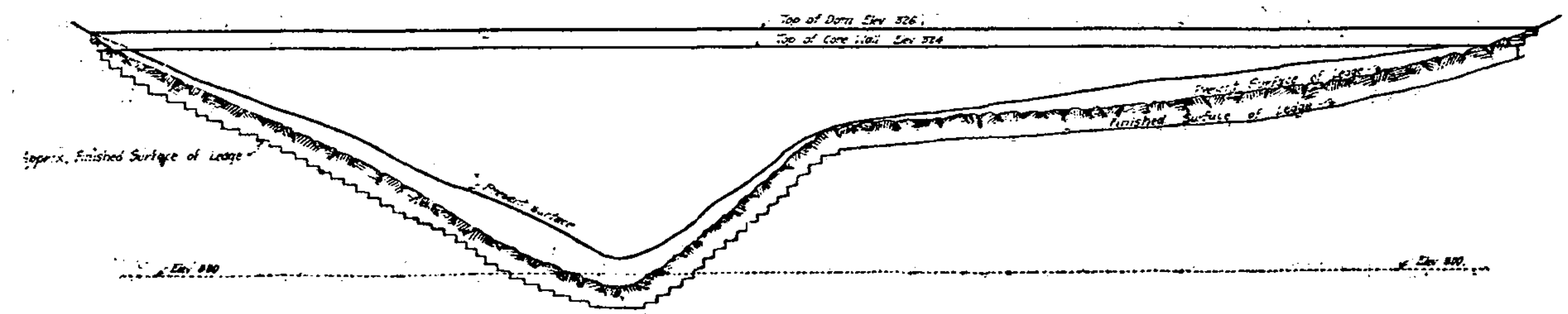
Cross Section of Dam.
Scale 10 ft. to 1 in.



Section through Inlet and Outlet Pipe.
Scale 10 ft. to 1 in.



Section through Overflow Pipe
Scale 10 ft. to 1 in.



Profile of Dam.
Scale Hor. 40 ft. to 1 in. Vert. 8 ft. to 1 in.

KENNEBEC WATER DISTRICT

RESERVOIR

IN WATERVILLE AND FAIRFIELD

CONTRACT PLANS - SHEET NO. 2

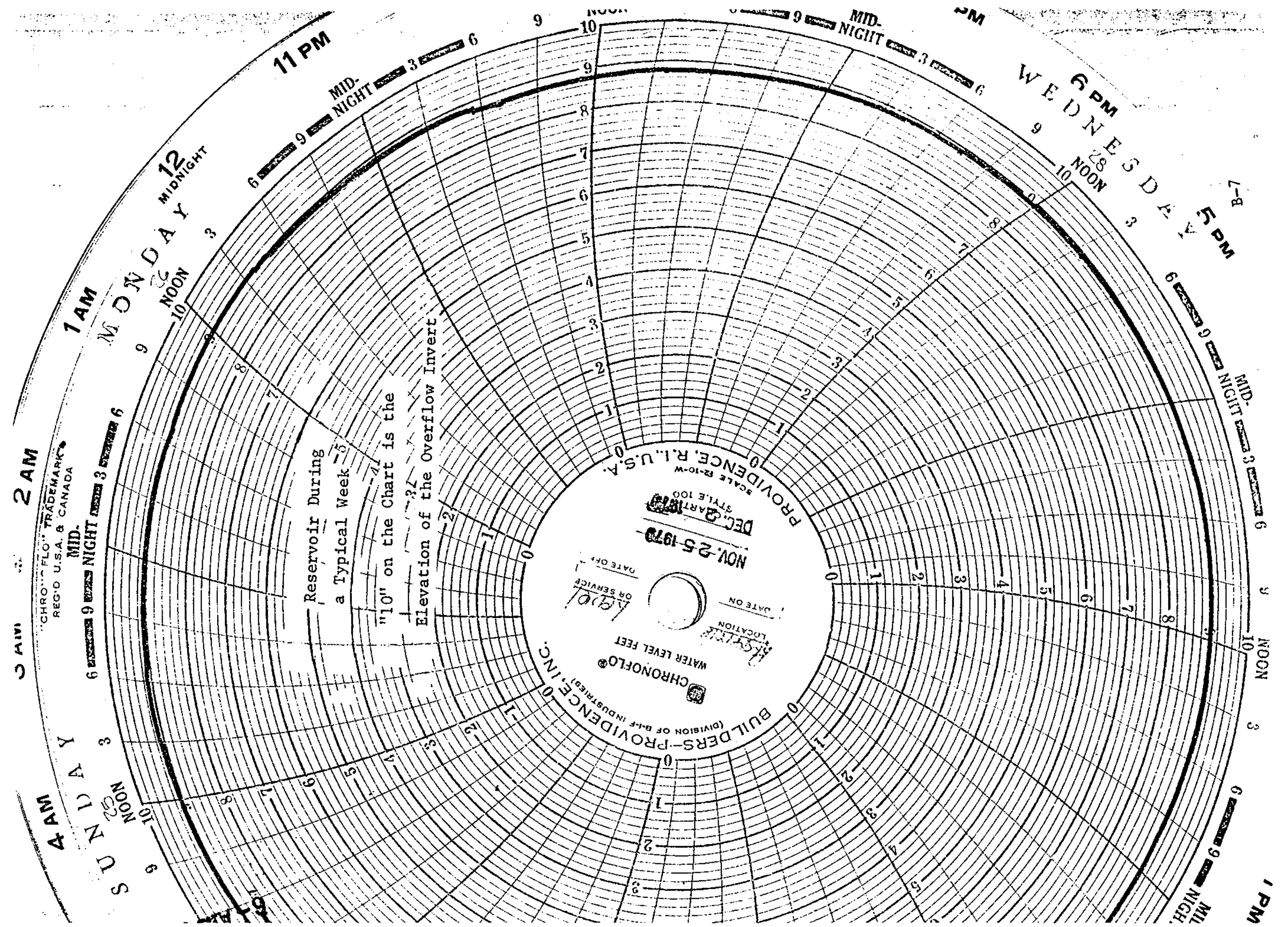
DETAILS OF DAM

SCALE AS SHOWN   AUGUST 21, 1916.

METCALF & EDDY
CONSULTING ENGINEERS
BOSTON - CHICAGO

REVISED - AUGUST 31, 1916.

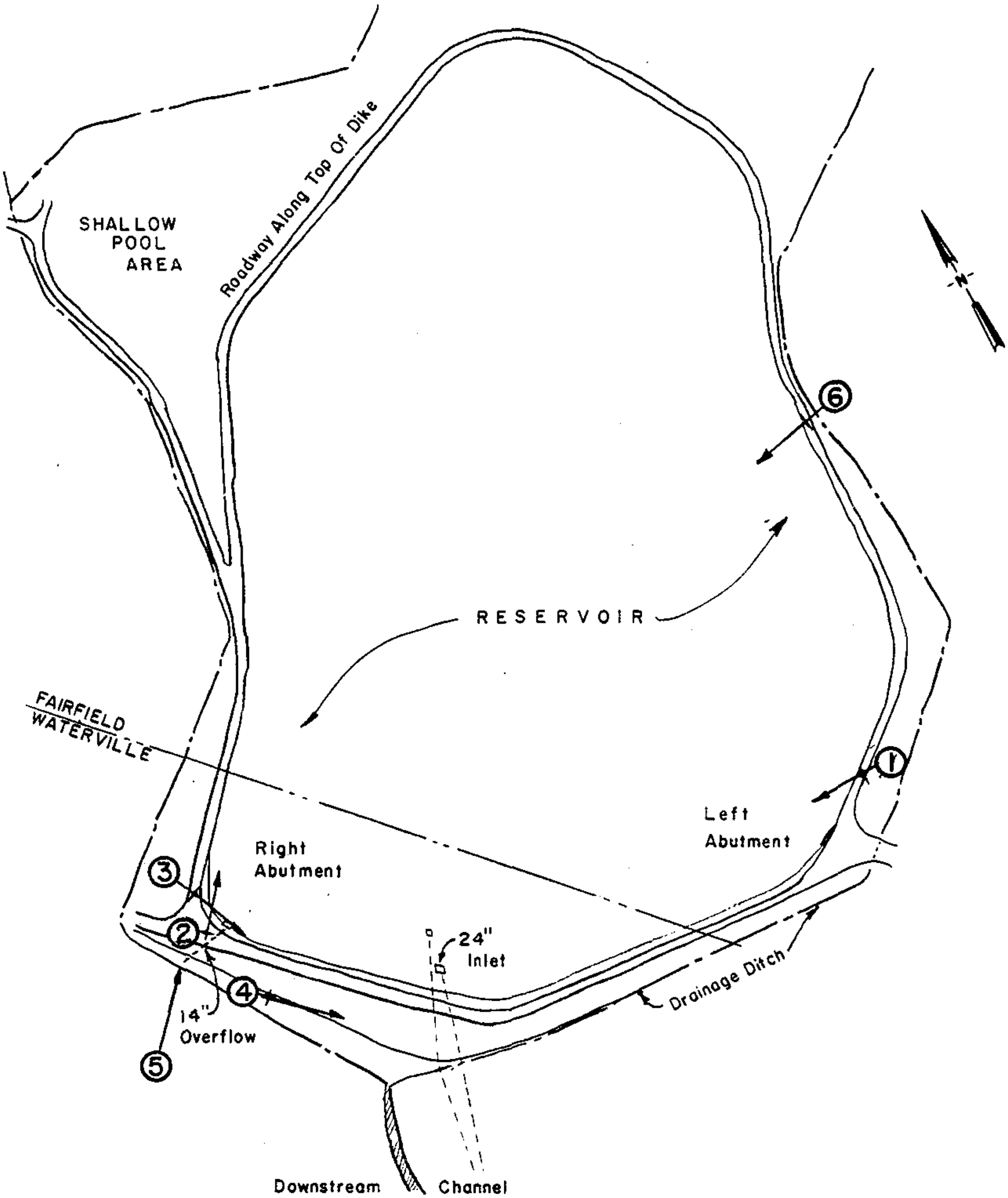
Metcalf & Eddy



Reservoir During a Typical Week
"10" on the Chart is the Elevation of the Overflow Invert

APPENDIX C

PHOTOGRAPHS



Not To Scale

LEGEND

(1) PHOTO LOCATION

RESERVOIR DAM
PHOTO LOCATION

U.S. ARMY CORPS OF ENGINEERS
PHASE I INSPECTION PROGRAM

DATE SEPT. 1981

MAIN

CLIENT JOB PLATE
1345-72

Photo 1

Upstream Face from Left Abutment

Photo 2

Upstream Right Abutment from Overflow Structure

Photo 3

Upstream Right Face with Concrete Overflow Structure

Photo 4

Downstream Face from Right Side.

Photo 5

Downstream Outlet of 14" Ø Overflow Pipe

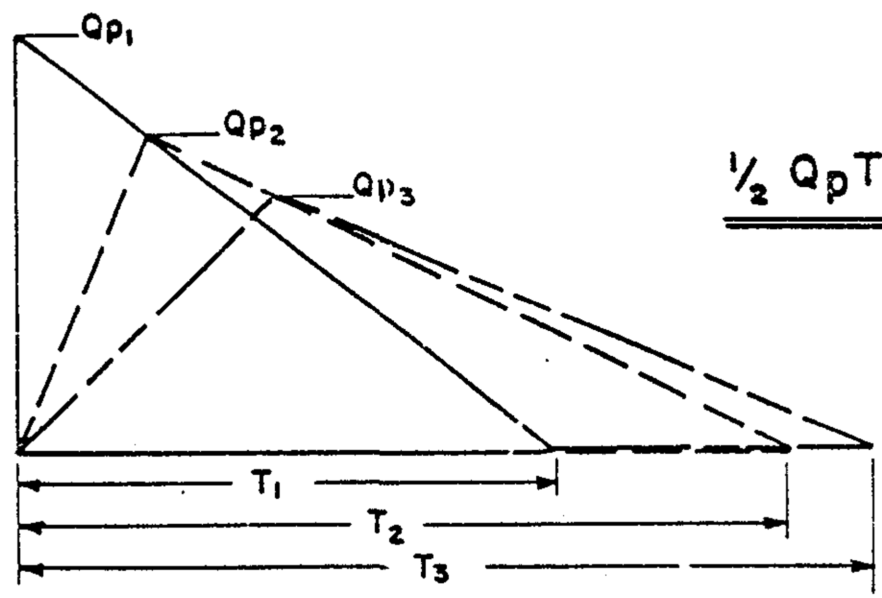
Photo 6

View Across Reservoir from Left Side Looking Towards Dam.

APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

"RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS



$$\frac{1}{2} Q_p T = 12\,S$$

STEP 1: DETERMINE OR ESTIMATE RESERVOIR STORAGE (S) IN AC-FT AT TIME OF FAILURE.

STEP 2: DETERMINE PEAK FAILURE OUTFLOW (Q_{p1}).

$$Q_{p1} = \frac{8}{27} W_b \sqrt{g}\, Y_o^{3/2}$$

W_b = BREACH WIDTH - SUGGEST VALUE NOT GREATER THAN 40% OF DAM LENGTH ACROSS RIVER AT MID HEIGHT.

Y_o = TOTAL HEIGHT FROM RIVER BED TO POOL LEVEL AT FAILURE.

STEP 3: USING USGS TOPO OR OTHER DATA, DEVELOP REPRESENTATIVE STAGE-DISCHARGE RATING FOR SELECTED DOWNSTREAM RIVER REACH.

STEP 4: ESTIMATE REACH OUTFLOW (Q_{p2}) USING FOLLOWING ITERATION.

A. APPLY Q_{p1} TO STAGE RATING, DETERMINE STAGE AND ACCOPMANYING VOLUME (V_1) IN REACH IN AC-FT. (NOTE: IF V_1 EXCEEDS 1/2 OF S, SELECT SHORTER REACH.)

B. DETERMINE TRIAL Q_{p2}.

$$Q_{p2}(\text{TRIAL}) = Q_{p1}\left(1 - \frac{V_1}{S}\right)$$

C. COMPUTE V_2 USING Q_{p2} (TRIAL).

D. AVERAGE V_1 AND V_2 AND COMPUTE Q_{p2}.

$$Q_{p2} = Q_{p1}\left(1 - \frac{V_{AVG}}{S}\right)$$

STEP 5: FOR SUCCEEDING REACHES REPEAT STEPS 3 AND 4.

APRIL 1978

SURCHARGE STORAGE ROUTING SUPPLEMENT

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Qp_2"

b. Avg "$STOR_1$" and "$STOR_2$" and Compute "Qp_3".

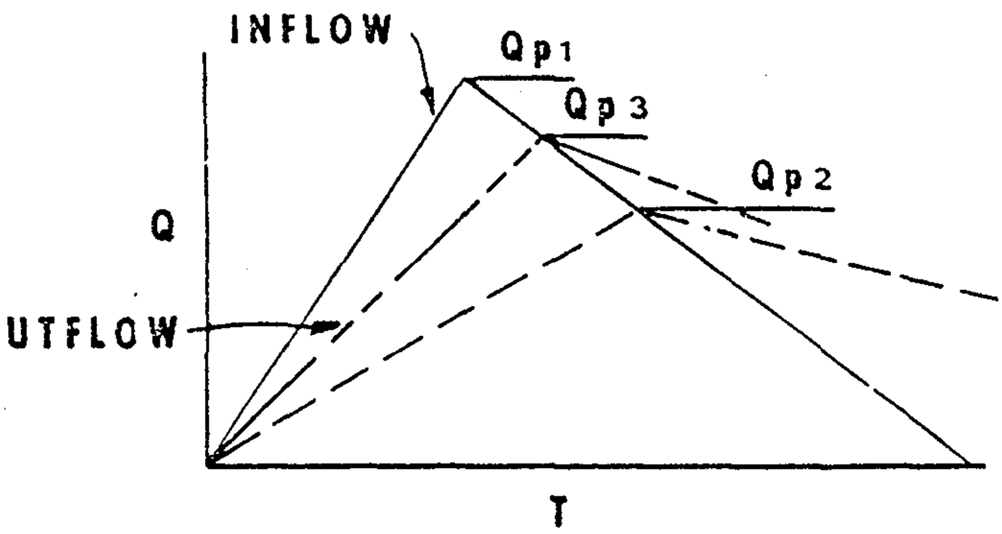
c. If Surcharge Height for Qp_3 and "$STOR_{AVG}$" agree O.K. If Not:

STEP 4: a. Determine Surcharge Height and "$STOR_3$" To Pass "Qp_3"

b. Avg. "Old $STOR_{AVG}$" and "$STOR_3$" and Compute "Qp_4"

c. Surcharge Height for Qp_4 and "New $STOR_{Avg}$" should Agree closely

ESTIMATING EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES



STEP 1: Determine Peak Inflow (Q_{p1}) from Guide Curves.

STEP 2: a. Determine Surcharge Height To Pass "Q_{p1}".

b. Determine Volume of Surcharge ($STOR_1$) In Inches of Runoff.

c. Maximum Probable Flood Runoff In New England equals Approx. 19", Therefore:

$$Q_{p2} = Q_{p1} \times \left(1 - \frac{STOR_1}{19}\right)$$

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Q_{p2}"

b. Average "$STOR_1$" and "$STOR_2$" and Determine Average Surcharge and Resulting Peak Outflow "Q_{p3}".

MAIN

Client CORPS OF ENGINEERS Job No. 1345-079 Sheet 1 of 33
Subject KENNEBEC RESERVOIR By T. OTOVA Date 4-29-80
FLOOD ROUTING Ckd. Rev.

Drainage Area = 0.25 sq. mi.

For drainage area of 0.25 sq. mi. (by extending the Corps of Engineers Curve) $q_{PMF} = 2750$ cfs/sq. mi.

The peak discharge becomes

$$q_{p_1} = 2750 \times 0.25 = 687.5 \text{ CFS.}$$

There is an intercepting ditch arround the reservoir area preventing the flows to inter into the reservoir. In addition the dam is raised to top elevation 330.0 FT. and a dike of top elevation 328.0 FT was constructed around the circumfrerence of the reservoir.

Due to this set-up no water is anticipated to interinto the reservoir except direct precipitation.

The PMP for this area is considered to be 19 inches which may rise the water elevation of the reservoir, about 1.6 ft. to elevation 327 + 1.6 = 328.6 FT which will be lower then the crest elevation of the dam (330.0 FT).

The water surface elevation 328.6 FT. is considered in dam breach analyses.

MAIN

Client CORPS OF ENGINEERS Job No. 1345-071 Sheet 2 of 33

Subject KENNEBEC RESERVOIR By T. OTOVA Date 4-30-80

FLOOD ROUTING Ckd. Rev.

	ELV. (ft)	CAPACITY (GALLONS)	CAPACITY (AC-FT)
1	304	14,000	0.043
2	305	51,000	0.157
3	306	121,000	0.371
4	307	237,000	0.727
5	308	407,000	1.249
6	309	639,000	1.961
7	310	953,000	2.925
8	311	1,369,000	4.202
9	312	1,909,000	5.859
10	313	2,605,000	7.995
11	314	3,494,000	10.723
12	315	4,632,000	14.216
13	316	6,082,000	18.666
14	317	7,973,000	24.470
15	318	10,421,000	31.983
16	319	13,217,000	40.564
17	320	16,107,000	49.434
18	322	22,000,000	67.520
19	323	25,200,000	77.341
20	324	29,200,000	89.618
21	325	33,400,000	102.508
22	326	37,300,000	114.477
23	327	40,000,000	122.764

MAIN

Client CORPS OF ENGINEERS — Job No. 1345-071 — Sheet 3 of 33

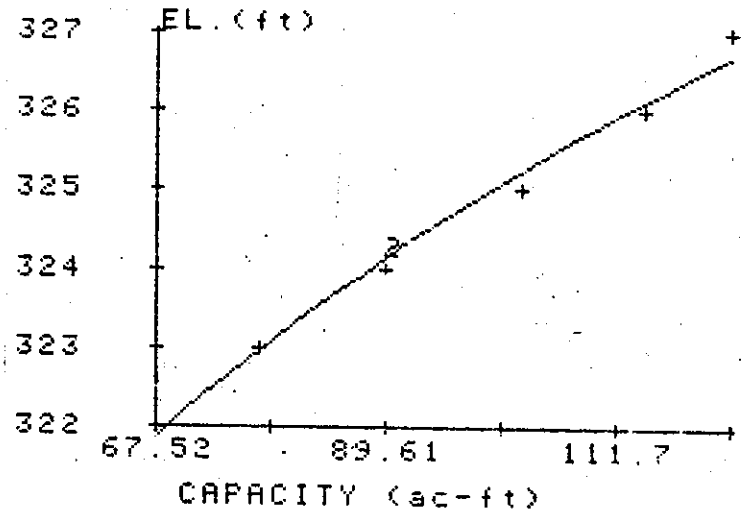
Subject KENNEBEC RESERVOIR — By T. OTOUA — Date 4-30-80

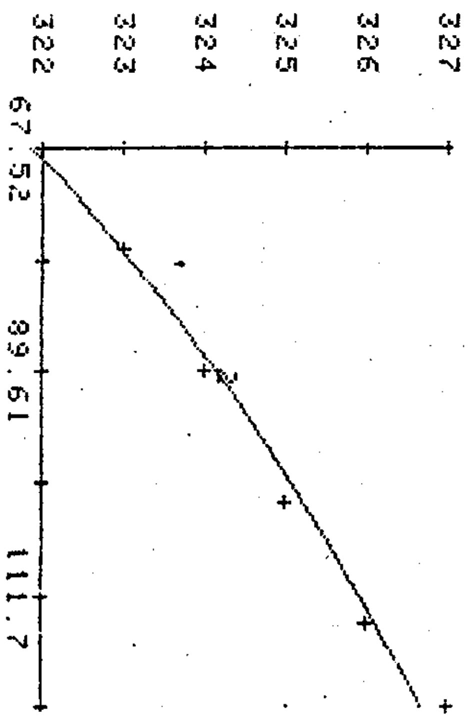
FLOOD ROUTING — Ckd. ______ — Rev. ______

CURVE FITTING

```
I          X(I)            Y(I)
1         77.3410        323.0000
2         89.6180        324.0000
3        102.5080        325.0000
4        114.4770        326.0000
5        122.7640        327.0000
6         67.5200        322.0000
ABEL  DELETED  AT         78.5688
ABEL  DELETED  AT        100.6664
ABEL  DELETED  AT        122.7640
  AOV: LOG REG:CODE 2
OURCE/DF       SS        MS       F
OTAL   5      17.5
EG     1      17.3      17.3  331.0
ESID   4       0.2       0.1
 SQUARE =           0.988

HAT=    287.992+      8.042LOG X
```





MAIN

Client: CORPS OF ENGINEERS — Job No. 1345-072 — Sheet 4 of 33
Subject: KENNEBEC RESERVOIR FLOOD ROUTING — By T. OTOVA — Date 6-5-80
Ckd. — Rev.

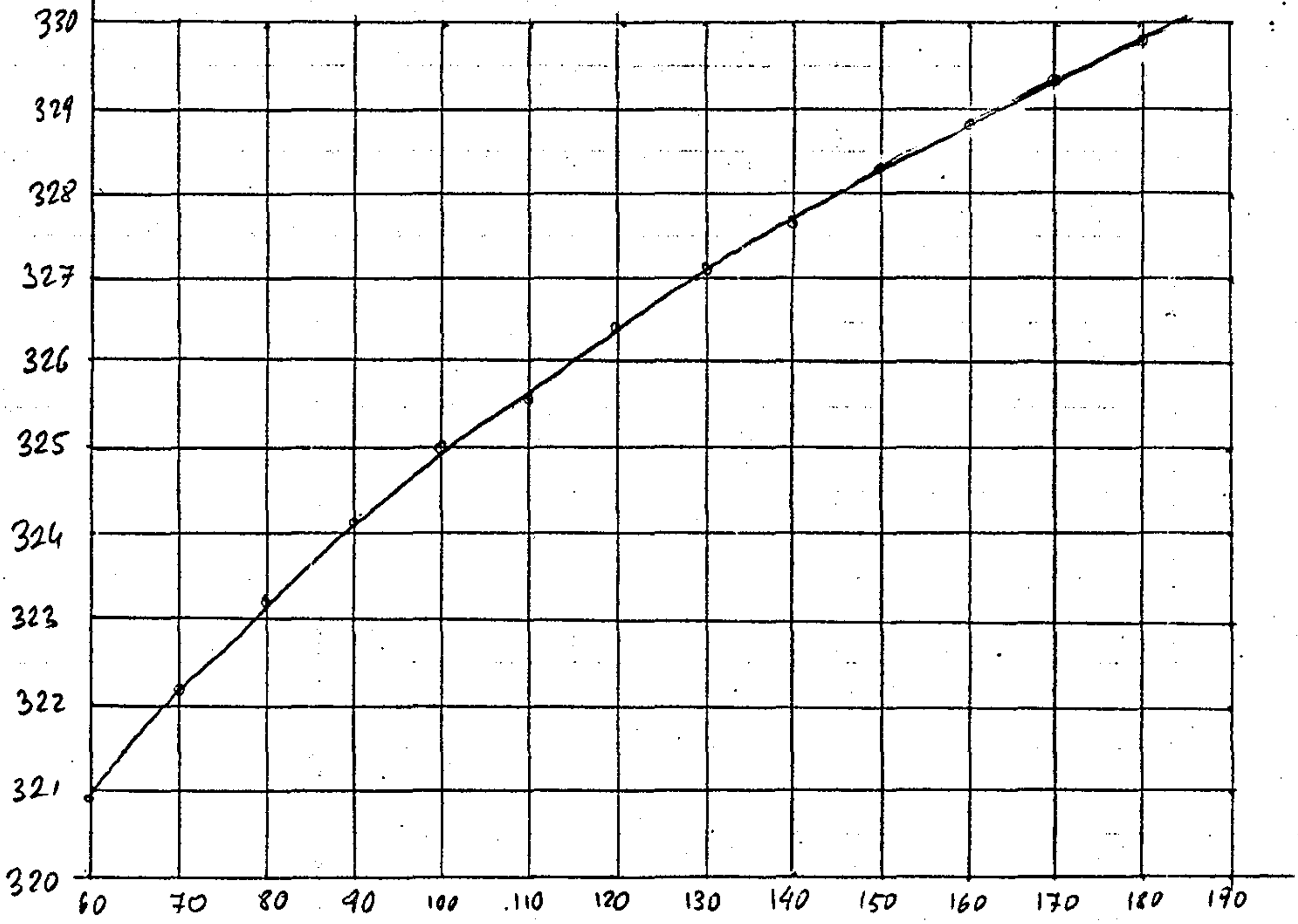
$$Y(\text{Elev}) = 287.992 + 8.042 \, \text{LOG}\, X(\text{capacity})$$

or,

$$X(\text{capacity}) = \text{Exp}\left[\frac{Y(\text{Elv}) - 287.992}{8.042}\right]$$

Y in (ft), X in (ac-ft).

ELEV. - CAPACITY CURVE



Capacity in AC-FT.

STEP 1: Reservoir Storage at time of failure $W_R = 155.9$ AC-FT.
ELV = 328.6 FT.

STEP 2: The Failure outflow peak Qp_1,

$$Qp_1 = \frac{8}{27} W_b \sqrt{g}\, Y_0^{3/2}$$ (Ref. Corps of Eng. Guidelines)

Where,

W_b = Breach width : (ft.)

$W_b = \frac{0.40}{\cancel{0.35}} W_d$

W_d = Dam Length.

$W_b = 0.40 \cdot 735$ ft. = 294.0 FT.

Y_0 = Total Height from river bed to pool level at failure

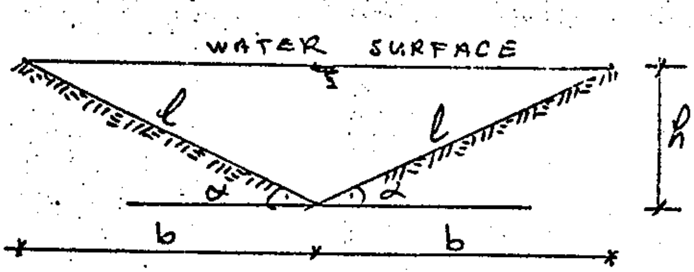
$Y_0 = 25.6$ ft. (328.6 − 303.0)

STEP 3: Derivation of Stage – Discharge Relationship

For simplification the cross-sections in any reach are converted as triangular shape.

Area, $A = \frac{h \times b}{2} \times 2$

$A = h \times b$



$\frac{h}{b} = \tan\alpha$ $\qquad b = \frac{h}{\tan\alpha}$

$A = \frac{h^2}{\tan\alpha}$ I

Wetted Parameter, W,

$$W = 2l \qquad \frac{b}{l} = \cos\alpha \qquad l = \frac{b}{\cos\alpha}$$

$$W = 2\frac{b}{\cos\alpha}$$

Hydraulic Radius, R,

$$R = \frac{A}{W} = \frac{bh}{2\frac{b}{\cos\alpha}} = \frac{h}{2}\cdot\cos\alpha \qquad R^{2/3} = \left(\frac{h\cos\alpha}{2}\right)^{2/3}$$

Manning's Formula, $Q = \frac{1.49\, A\, R^{2/3} S^{1/2}}{n}$

S is slope
n is roughness coefficient

$$Q = \frac{1.49}{n} \times \frac{h^2}{\tan\alpha} \times \left(\frac{h\cos\alpha}{2}\right)^{2/3} \times S^{1/2}$$

$$Q = \frac{1.49}{n} \times \frac{S^{1/2}}{\tan\alpha} \times \frac{(\cos\alpha)^{2/3}}{2^{2/3}} \times h^{8/3}$$

$$h = \left[\frac{n \times \tan\alpha \times 2^{2/3}}{1.49 \times (\cos\alpha)^{2/3} \times S^{1/2}} \times Q\right]^{3/8}$$

$$\boxed{h = \left[\frac{1.068 \times n \times \tan\alpha}{(\cos\alpha)^{2/3} \times S^{1/2}} \cdot Q\right]^{3/8}} \quad \ldots\ldots \text{II}$$

THIS IS THE RATING FORMULA USED IN ALL REACHES

STEP 4: For this steps a computer program is developed which is presented in pages 8 trough. The results are tabulated in page 7.

MAIN

Client: CORPS OF ENGINEERS — Job No. 1345-072 — Sheet 7 of 33

Subject: KENNEBEC DAM FAILURE ANALYSIS — By T. OTOVA — Date 2-24-81

Ckd. ______ Rev. ______

There is no emergency spillway and the only spillway is 14 inches overflow pipe at elev. 327. Maximum water elev. during test flood is 328.6 and with 1.6 ft. head the discharge from the pipe is assumed to be minimal for a study for prefailure conditions.

KENNEBEC DAM
DAM FAILURE ANALYSES

These calculations are performed according to the RULE OF THUMB procedures of the Corps of Engineers

The breach discharge:
Qp1 = 8/27 * Wb * g^0.5 * Yo^3/2

Where,

Yo is the height of the breach (from river bed to the max. pool level)

Wb is 35% of the length of the dam, or Wb = .35 * Wd

g is the acceleration of the gravity (32.2 ft/sec^2)

Yo = 25.6 (ft)

Wd = 735 (ft)

Wb = 257 (ft)

From above equation,
Qp1 = 56023 (cfs)

The natural channel cross sections are simplyfied as triangular cross sections

The stage-discharge relationship becomes as,

h = [1.068 * n * Tan(a) * Q / Cos(a)^2/3 / S^.5]^3/8....(I)

Where,

Q = Discharge (cfs)
a = Side slope angle (deg)
S = Channel slope

The cross section Area:

A = h^2 / Tan(a) ....(II)

The Volume of the Reservoir,
V = 155.9 (ac-ft)
or,
V = 6791004 (cub-ft)

R E A C H (1) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 3.81 (deg.)
S = .04
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II),

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 15.1 (ft)

From Formula (II),
Total Area,
A = 3430 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 3430 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 1200727 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 46117 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 46117 (cfs)

h = 14 (ft)

From Formula (II),

A = 2964 (ft)

Residual Area,

A2 = A - A1

A2 = 2964 (ft)

V2 = A2 * L

V2 = 1037692 (cub-ft)

Vavg = (V1 + V2) / 2

Vave = 1119209 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 46790 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 14.1 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 14.1 (ft)

3.) Breach Discharge = 46790 (cfs)

4.) Reach Length = 350 (ft)

REACH (2) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 3.81 (deg.)
S = .04
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 14.1 (ft)

From Formula (II),
Total Area,
A = 2997 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 2997 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 1049020 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 39562 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 39562 (cfs)

h = 13 (ft)

From Formula (II),

A = 2642 (ft)

Residual Area,

A2 = A - A1

A2 = 2642 (ft)

V2 = A2 * L

V2 = 924975 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 986998 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 39989 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 13.3 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 13.3 (ft)

3.) Breach Discharge = 39989 (cfs)

4.) Reach Length = 350 (ft)

MAIN

Client: CORPS OF ENGINEERS — Job No. 1345-072 — Sheet 10 of 33

Subject: KENNEBEC DAM FAILURE ANALYSIS — By T. OTOVA — Date 2-24-81

Ckd. — Rev.

R E A C H (3) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 3.81 (deg.)
S = .04
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 13.3 (ft)

From Formula (II),
Total Area,
A = 2664 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 2664 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 932458 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 34498 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 34498 (cfs)

h = 12 (ft)

From Formula (II),

A = 2384 (ft)

Residual Area,

A2 = A - A1

A2 = 2384 (ft)

V2 = A2 * L

V2 = 834682 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 883570 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 34786 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 12.6 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 12.6 (ft)

3.) Breach Discharge = 34786 (cfs)

4.) Reach Length = 350 (ft)

R E A C H (4) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 3.81 (deg.)
S = .04
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 12.6 (ft)

From Formula (II),
Total Area,
A = 2399 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 2399 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 839901 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 30484 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 30484 (cfs)

h = 12 (ft)

From Formula (II),

A = 2173 (ft)

Residual Area,

A2 = A - A1

A2 = 2173 (ft)

V2 = A2 * L

V2 = 760721 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 800311 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 30687 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 12 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 12 (ft)

3.) Breach Discharge = 30687 (cfs)

4.) Reach Length = 350 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-072 Sheet 12 of 33
Subject KENNEBEC DAM By T. OTOVA Date 2-24-81
FAILURE ANALYSIS Ckd. Rev.

R E A C H (5) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 3.81 (deg.)
S = .04
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 12 (ft)

From Formula (II),
Total Area,
A = 2184 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 2184 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 764514 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 27232 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 27232 (cfs)

h = 11 (ft)

From Formula (II),

A = 1997 (ft)

Residual Area,

A2 = A - A1

A2 = 1997 (ft)

V2 = A2 * L

V2 = 699009 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 731761 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 27380 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 11.5 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 11.5 (ft)

3.) Breach Discharge = 27380 (cfs)

4.) Reach Length = 350 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-OF2 Sheet 13 of 33
Subject KENNEBEC DAM By T. OTOVA Date 2-24-81
FAILURE ANALYSIS Ckd. Rev.

R E A C H (6) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 3.81 (deg.)
S = .04
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 11.5 (ft)

From Formula (II),
Total Area,
A = 2005 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 2005 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 701857 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 24550 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 24550 (cfs)

h = 11 (ft)

From Formula (II),

A = 1847 (ft)

Residual Area,

A2 = A - A1

A2 = 1847 (ft)

V2 = A2 * L

V2 = 646718 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 674288 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 24661 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 11.1 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 11.1 (ft)

3.) Breach Discharge = 24661 (cfs)

4.) Reach Length = 350 (ft)

R E A C H (7) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 3.81 (deg.)
S = .04
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 11.1 (ft)

From Formula (II),
Total Area,
A = 1854 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1854 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 648913 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 22305 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 22305 (cfs)

h = 10 (ft)

From Formula (II),

A = 1719 (ft)

Residual Area,

A2 = A - A1

A2 = 1719 (ft)

V2 = A2 * L

V2 = 601829 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 625371 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 22390 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 10.7 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 10.7 (ft)

3.) Breach Discharge = 22390 (cfs)

4.) Reach Length = 350 (ft)

R E A C H (8) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 3.81 (deg.)
S = .04
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 10.7 (ft)

From Formula (II),
Total Area,
A = 1724 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1724 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 603558 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 20400 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 20400 (cfs)

h = 10 (ft)

From Formula (II),

A = 1608 (ft)

Residual Area,

A2 = A - A1

A2 = 1608 (ft)

V2 = A2 * L

V2 = 562863 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 583210 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 20467 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 10.3 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 10.3 (ft)

3.) Breach Discharge = 20467 (cfs)

4.) Reach Length = 350 (ft)

R E A C H (9) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 3.81 (deg.)
S = .04
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 10.3 (ft)

From Formula (II),
Total Area,
A = 1612 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1612 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 564250 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 18767 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 18767 (cfs)

h = 10 (ft)

From Formula (II),

A = 1510 (ft)

Residual Area,

A2 = A - A1

A2 = 1510 (ft)

V2 = A2 * L

V2 = 528710 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 546480 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 18820 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 10 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 10 (ft)

3.) Breach Discharge = 18820 (cfs)

4.) Reach Length = 350 (ft)

R E A C H (10) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1.15 (deg.)
S = .0133
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II),

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 7.8 (ft)

From Formula (II),
Total Area,
A = 3084 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 3084 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 1079542 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 15828 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 15828 (cfs)

h = 7 (ft)

From Formula (II),

A = 2708 (ft)

Residual Area,

A2 = A - A1

A2 = 2708 (ft)

V2 = A2 * L

V2 = 948090 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 1013816 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 16011 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 7.4 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 7.4 (ft)

3.) Breach Discharge = 16011 (cfs)

4.) Reach Length = 350 (ft)

R E A C H (11) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1.15 (deg.)
S = .0133
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 7.4 (ft)

From Formula (II),
Total Area,
A = 2732 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 2732 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 956261 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 13756 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 13756 (cfs)

h = 6 (ft)

From Formula (II),

A = 2438 (ft)

Residual Area,

A2 = A - A1

A2 = 2438 (ft)

V2 = A2 * L

V2 = 853380 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 904820 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 13877 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 7 (ft)

RESULTS :

1.) Prefailure Height = 6 (ft)

2.) Postfailure Height = 7 (ft)

3.) Breach Discharge = 13877 (cfs)

4.) Reach Length = 350 (ft)

REACH (12) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1.15 (deg.)
S = .0133
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 7 (ft)

From Formula (II),
Total Area,
A = 2454 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 2454 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 859016 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 12122 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 12122 (cfs)

h = 6 (ft)

From Formula (II),

A = 2217 (ft)

Residual Area,

A2 = A - A1

A2 = 2217 (ft)

V2 = A2 * L

V2 = 776160 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 817588 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 12207 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 6.6 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 6.6 (ft)

3.) Breach Discharge = 12207 (cfs)

4.) Reach Length = 350 (ft)

R E A C H (13) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1.15 (deg.)
S = .0133
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 6.6 (ft)

From Formula (II),
Total Area,
A = 2229 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 2229 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 780221 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 10804 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 10804 (cfs)

h = 6 (ft)

From Formula (II),

A = 2034 (ft)

Residual Area,

A2 = A - A1

A2 = 2034 (ft)

V2 = A2 * L

V2 = 711976 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 746099 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 10865 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 6.4 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 6.4 (ft)

3.) Breach Discharge = 10865 (cfs)

4.) Reach Length = 350 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-072 Sheet 21 of 33
Subject KENNEBEC DAM By T. OTOVA Date 2-24-81
FAILURE ANALYSIS Ckd. Rev.

R E A C H (14) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1.15 (deg.)
S = .0133
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 6.4 (ft)

From Formula (II),
Total Area,
A = 2042 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 2042 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 715006 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 9721 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 9721 (cfs)

h = 6 (ft)

From Formula (II),

A = 1879 (ft)

Residual Area,

A2 = A - A1

A2 = 1879 (ft)

V2 = A2 * L

V2 = 657767 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 686386 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 9767 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 6.1 (ft)

RESULTS :

1) Prefailure Height = 0 (ft)

2.) Postfailure Height = 6.1 (ft)

3.) Breach Discharge = 9767 (cfs)

4.) Reach Length = 350 (ft)

MAIN

Client: CORPS OF ENGINEERS — Job No. 1345-072 — Sheet 22 of 33
Subject: KENNEBEC DAM FAILURE ANALYSIS — By T. OTOVA — Date 2-24-81
Ckd. ____ Rev. ____

R E A C H (15) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1.15 (deg.)
S = .0133
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 6.1 (ft)

From Formula (II),
Total Area,
A = 1885 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1885 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 660089 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 8818 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 8818 (cfs)

h = 5 (ft)

From Formula (II),

A = 1746 (ft)

Residual Area,

A2 = A - A1

A2 = 1746 (ft)

V2 = A2 * L

V2 = 611359 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 635724 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 8853 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 5.9 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 5.9 (ft)

3.) Breach Discharge = 8853 (cfs)

4.) Reach Length = 350 (ft)

REACH (16) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1.15 (deg.)
S = .0133
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 5.9 (ft)

From Formula (II),
Total Area,
A = 1751 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1751 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 613180 (cub-ft)

Qp2 = Qp1 * (1 - V1

Qp2 = 8053 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 8053 (cfs)

h = 5 (ft)

From Formula (II),

A = 1631 (ft)

Residual Area,

A2 = A - A1

A2 = 1631 (ft)

V2 = A2 * L

V2 = 571169 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 592174 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 8081 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 5.7 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 5.7 (ft)

3.) Breach Discharge = 8081 (cfs)

4.) Reach Length = 350 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-072 Sheet 26 of 33
Subject KENNEBEC DAM By T. OTOVA Date 2-24-81
FAILURE ANALYSIS Ckd. Rev.

R E A C H (17) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1.15 (deg.)
S = .0133
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 5.7 (ft)

From Formula (II),
Total Area,
A = 1636 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1636 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 572624 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 7399 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 7399 (cfs)

h = 5 (ft)

From Formula (II),

A = 1531 (ft)

Residual Area,

A2 = A - A1

A2 = 1531 (ft)

V2 = A2 * L

V2 = 536015 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 554320 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 7421 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 5.5 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 5.5 (ft)

3.) Breach Discharge = 7421 (cfs)

4.) Reach Length = 350 (ft)

R E A C H (18) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1.15 (deg.)
S = .0133
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 5.5 (ft)

From Formula (II),
Total Area,
A = 1534 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1534 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 537198 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 6834 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 6834 (cfs)

h = 5 (ft)

From Formula (II),

A = 1442 (ft)

Residual Area,

A2 = A - A1

A2 = 1442 (ft)

V2 = A2 * L

V2 = 505001 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 521100 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 6852 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 5.3 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 5.3 (ft)

3.) Breach Discharge = 6852 (cfs)

4.) Reach Length = 350 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-072 Sheet 26 of 33
Subject KENNEBEC DAM By T. OTOVIA Date 2-24-81
FAILURE ANALYSIS Ckd. Rev.

R E A C H (19) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1.15 (deg.)
S = .0133
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 5.3 (ft)

From Formula (II),
Total Area,
A = 1445 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1445 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 505976 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 6341 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 6341 (cfs)

h = 5 (ft)

From Formula (II),

A = 1364 (ft)

Residual Area,

A2 = A - A1

A2 = 1364 (ft)

V2 = A2 * L

V2 = 477430 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 491703 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 6355 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 5.2 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 5.2 (ft)

3.) Breach Discharge = 6355 (cfs)

4.) Reach Length = 350 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-072 Sheet 27 of 33
Subject KENNEBEC DAM By T. OTOVA Date 2-24-81
FAILURE ANALYSIS Ckd. Rev.

R E A C H (20) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1.15 (deg.)
S = .0133
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 5.2 (ft)

From Formula (II),
Total Area,
A = 1366 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1366 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 478243 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 5908 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 5908 (cfs)

h = 5 (ft)

From Formula (II),

A = 1293 (ft)

Residual Area,

A2 = A - A1

A2 = 1293 (ft)

V2 = A2 * L

V2 = 452754 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 465498 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 5920 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 5 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 5 (ft)

3.) Breach Discharge = 5920 (cfs)

4.) Reach Length = 350 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-0F2 Sheet 28 of 33
Subject KENNEBEC DAM By T. OTOVA Date 2-24-81
FAILURE ANALYSIS Ckd. Rev.

R E A C H (21) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1.15 (deg.)
S = .0133
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 5 (ft)

From Formula (II),
Total Area,
A = 1295 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1295 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 453440 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 5525 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 5525 (cfs)

h = 4 (ft)

From Formula (II),

A = 1230 (ft)

Residual Area,

A2 = A - A1

A2 = 1230 (ft)

V2 = A2 * L

V2 = 430537 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 441988 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 5534 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 4.9 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 4.9 (ft)

3.) Breach Discharge = 5534 (cfs)

4.) Reach Length = 350 (ft)

MAIN

Client: CORPS OF ENGINEERS — Job No. 1345-072 — Sheet 29 of 33
Subject: KENNEBEC DAM FAILURE ANALYSIS — By T. OTOVA — Date 2-24-81
Ckd. — Rev.

R E A C H (22) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1.15 (deg.)
S = .0133
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 4.9 (ft)

From Formula (II),
Total Area,
A = 1231 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1231 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 431120 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 5183 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 5183 (cfs)

h = 4 (ft)

From Formula (II),

A = 1172 (ft)

Residual Area,

A2 = A - A1

A2 = 1172 (ft)

V2 = A2 * L

V2 = 410426 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 420773 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 5192 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 4.8 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 4.8 (ft)

3.) Breach Discharge = 5192 (cfs)

4.) Reach Length = 350 (ft)

R E A C H (23) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1 (deg.)
S = .01
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 4.8 (ft)

From Formula (II),
Total Area,
A = 1353 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1353 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 473561 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 4829 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 4829 (cfs)

h = 4 (ft)

From Formula (II),

A = 1281 (ft)

Residual Area,

A2 = A - A1

A2 = 1281 (ft)

V2 = A2 * L

V2 = 448571 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 461066 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 4839 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 4.7 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 4.7 (ft)

3.) Breach Discharge = 4839 (cfs)

4.) Reach Length = 350 (ft)

MAIN

Client: CORPS OF ENGINEERS — Job No. 1345-072 — Sheet 31 of 33

Subject: KENNEBEC DAM FAILURE ANALYSIS — By T. OTOVA — Date 2-24-81

Ckd. ____ Rev. ____

R E A C H (24) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1 (deg.)
S = .01
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 4.7 (ft)

From Formula (II),
Total Area,
A = 1283 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1283 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 449237 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 4519 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 4519 (cfs)

h = 4 (ft)

From Formula (II),

A = 1219 (ft)

Residual Area,

A2 = A - A1

A2 = 1219 (ft)

V2 = A2 * L

V2 = 426759 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 437998 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 4527 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 4.6 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 4.6 (ft)

3.) Breach Discharge = 4527 (cfs)

4.) Reach Length = 350 (ft)

R E A C H (25) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1 (deg.)
S = .01
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 4.6 (ft)

From Formula (II),
Total Area,
A = 1220 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1220 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 427326 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 4242 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 4242 (cfs)

h = 4 (ft)

From Formula (II),

A = 1162 (ft)

Residual Area,

A2 = A - A1

A2 = 1162 (ft)

V2 = A2 * L

V2 = 406996 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 417161 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 4249 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 4.5 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 4.5 (ft)

3.) Breach Discharge = 4249 (cfs)

4.) Reach Length = 350 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-072 Sheet 33 of 33
Subject KENNEBEC DAM By T. OTOVIA Date 2-24-81
FAILURE ANALYSIS Ckd. Rev.

R E A C H (26) CALCULATIONS

Test flood discharge:
Qt = 0 (cfs)

a = 1 (deg.)
S = .01
n = .07
L = 350 (ft)

From Formula (I),

Prefailure height,

h1 = 0 (ft)

From Formula (II) ,

A1 = 0 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 4.5 (ft)

From Formula (II),
Total Area,
A = 1164 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 1164 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 407483 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 3994 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 3994 (cfs)

h = 4 (ft)

From Formula (II),

A = 1111 (ft)

Residual Area,

A2 = A - A1

A2 = 1111 (ft)

V2 = A2 * L

V2 = 389004 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 398244 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 4000 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 4.4 (ft)

RESULTS :

1.) Prefailure Height = 0 (ft)

2.) Postfailure Height = 4.4 (ft)

3.) Breach Discharge = 4000 (cfs)

4.) Reach Length = 350 (ft)

APPENDIX E

INVENTORY SHEETS

PART I – INVENTORY OF DAMS IN THE UNITED STATES

(PURSUANT TO PUBLIC LAW 92-367)

See reverse side for instructions.

FORM APPROVED
OMB NO. 49-R0421

REQUIREMENTS CONTROL SYMBOL
DAEN-CWE-17

[1]

STATE (1-2)	IDENTITY NUMBER (3-7)
ME	00472

IDENTIFICATION

[2] DIVISION	[3] STATE	[4] COUNTY	[5] CONGR DIST	[6] STATE	[7] COUNTY	[8] CONGR DIST	[9] NAME	[10] LATITUDE (North)	[11] LONGITUDE (West)	[12] REPORT DATE DAY MO YR	80
NED	ME	011	01				RESERVOIR DAM	4435.0	6938.6	2 MAR 81	0

IDENTIFICATION (Continued)

[13] POPULAR NAME	[14] NAME OF IMPOUNDMENT	80
SAME	CHINA LAKE	1

LOCATION

[15] REGION	[16] BASIN	[17] RIVER OR STREAM	[18] NEAREST DOWNSTREAM CITY – TOWN – VILLAGE	[19] DIST. FROM DAM (mi)	[20] POPULATION	80
01	03	TR-KENNEBEC RIVER	WATERVILLE	2	20000	2

STATISTICS

[21] TYPE OF DAM	[22] YEAR COMPLETED	[23] PURPOSES	[24] STRUCTURAL HEIGHT (ft)	[25] HYDRAULIC HEIGHT (ft)	[26] IMPOUNDING CAPACITIES MAXIMUM (acre – ft.)	[27] IMPOUNDING CAPACITIES NORMAL (acre – ft.)	[27A] CORPS ENGR. DIST.	[27B] OWN.	[27C] FED. R.	[27D] PRV/FED	[27E] SCS A.	[27F] VERIFICATION DATE DA MO YR	BLANK	80
ERPG	1918	S	35	35	122	114	NED	N	N	N	N			3

REMARKS

[28] REMARKS	80
	4

ENG FORM 1 DEC 77 4474

GENERAL INSTRUCTIONS

This form is for use in preparing the inventory of dams in the United States under the requirements of the National Program for the Inspection of Dams, P.L. 92-367. All items of Part I and Part II (Lines 0-9) must be completed as instructed below. Print entries distinctly in ink or pencil. For letters o, z, and i, write Ø, Ƶ, and I.

Write only one letter or numeral in each space; do not use more letters than blocks allowed for an item. Do not abbreviate on Part I. Leave one space between words and no space between code letters.

For all letter codes or word entries place first letters in left block of field. In word fields any alphabetic, numeric or special character may be entered. For all numerical entries, use only numerals placing the last digit of number in the right block of field, including trailing zeros. Do not include a decimal point! In fields where decimals are required values are to be placed around the decimal point printed on the form.

Leave blank those spaces where item does not apply, e.g., do not write "N/A", "–", "None", etc., unless instructed to do so by specific instructions. Use the remarks line when additional space is needed for an item, or to clarify an entry. Preface each remark with the item number. (See Item |28| or |56| instructions)

PART I

Item | 1 | IDENTITY: The Division Engineer will assign and control the identity for dams in the states for which he is responsible. The first two characters of the identity will be the two-letter state abbreviation in accordance with Federal Information Processing Standards Publication, June 15, 1970 (FIPS PUB 6-1). In cases where a dam is physically located in two or more states, one state will be designated as the principal state for the identity. The last five (5) characters of the identity will be a sequential number assigned to identify dams within a state.

LINE 0:

Item | 2 | DIVISION: Enter the three (3) letter office symbol for the division making the report in accordance with ABBR Report Code, Appendix B, ER 18-2-1, Civil Works Information System; e.g., NAD, ORD, SWD, etc.

Location:

Item | 3 | STATE: Enter two (2) letter principal state abbreviation in accordance with FIPS PUB 6-1.
Item | 4 | COUNTY: Enter three (3) digit county identification in accordance with FIPS PUB 6-1.
Item | 5 | CONG DIST: Enter one (1) or two (2) digit number for congressional districts in which dam is located.
Item | 6 |, | 7 |, and | 8 | (Use second location for structures situated in more than one state.)

Item | 9 | DAM NAME: Enter official name of dam. Do not abbreviate unless the abbreviation is a part of the official name. For dams that do not have a name, create a name by combining the two (2) letter state abbreviation plus "NO NAME" plus a sequential number. Example: if two dams in the State of Alabama do not have names, they would be named as ALNONAME1 and ALNONAME2.
Item |10| & |11| LATITUDE AND LONGITUDE: Enter the latitude and longitude in degrees, minutes and tenths of a minute. All geographical location items pertain to dam as its maximum section.
Item |12| REPORT DATE: Enter the one (1) or two (2) digits for day, the first three (3) letters of the month and a two (2) digit year (e.g., 12 JAN74) in which the data has been revised, updated or otherwise changed.

LINE 1:

Item |13| POPULAR NAME OF DAM: If (other than the official name of the dam) in common use, enter the name in this space. Leave blank if not applicable.
Item |14| NAME OF IMPOUNDMENT: Enter official name of lake or reservoir. Leave blank if reservoir does not have a name.

LINE 2:

Item |15| & |16| REGION AND BASIN: Enter two (2) digit numbers for Region and Basin in accordance with Appendix C, ER 18-2-1, Civil Works Information System.
Item |17| RIVER OR STREAM: Enter official name of river or stream on which the dam is built. If stream is without name, indicate as tributary to river named, e.g., TR-COLORADO. If off stream, enter name of river plus "OFFSTREAM".
Item |18| NEAREST DOWNSTREAM CITY-TOWN-VILLAGE: Enter the nearest downstream city-town-village of such size which can be located on a general map.
Item |19| DISTANCE FROM DAM: Enter distance from dam to nearest downstream city-town-village to the nearest mile.
Item |20| POPULATION: Enter population of city-town-village given in Item |18|

LINE 3:

Item |21| TYPE OF DAM: Enter two (2) letter codes, in any order, to describe type of dam.

EARTH – RE	BUTTRESS – CB	OTHER – OT
ROCKFILL – ER	ARCH – VA	(Describe "other" in remarks)
GRAVITY PG	MULTI-ARCH – MV	

Item |22| YEAR COMPLETED: Enter year when the main dam structure was completed and ready for use. If only approximate year can be determined, note this in remarks.
Item |23| PURPOSES: Enter one (1) letter codes that describe the purposes for which the reservoir is used. The order entered should indicate the relative decreasing importance of the project purposes.

IRRIGATION – I	WATER SUPPLY – S	DEBRIS CONTROL – D
HYDROELECTRIC – H	RECREATION – R	OTHER – O
FLOOD CONTROL – C	STOCK OR SMALL	(Describe "other" in remarks)
NAVIGATION – N	FARM POND – P	

Item |24| STRUCTURAL HEIGHT: Enter, to the nearest foot, the structural height of the dam which is defined as: the overall vertical distance from the lowest point of foundation surface to the top of the dam.
Item |25| HYDRAULIC HEIGHT: Enter, to the nearest foot, the hydraulic height of the dam which is defined as; the effective height of the dam with respect to the maximum storage capacity, measured from the natural bed of the stream or watercourse at the downstream toe of the barrier, or if it is not across a stream or watercourse, the height from the lowest elevation of the outside limit of the barrier to the maximum storage elevation.

Impounding Capabilities:

Item |26| MAXIMUM: Enter the acre feet for maximum storage which is defined as: the total storage space in a reservoir below the maximum attainable water surface elevation, including any surcharge storage.
Item |27| NORMAL: Enter the acre feet for normal storage which is defined as; the total storage space in a reservoir below the normal retention level, including dead and inactive storage and excluding any flood control or surcharge storage.

Item |27A| CORPS OF ENGINEERS DISTRICT: Enter the three character Corps of Engineers ABBR report code in which the dam is geographically located, in accordance with Appendix B, ER 19-2-1, Civil Works Information System, e.g., NAN, ORH, SWF, etc.
Item |27B| OWNERSHIP: Enter N, for Non-Federal; G, for Federal Gov't. Agencies other than the Corps of Engineers; C for Corps of Engineers.
Item |27C| FEDERALLY REGULATED: Enter N for No; Enter Y for Yes.
Item |27D| PRIVATE DAMS ON FEDERAL LAND: Enter N for No; Enter Y for Yes.
Item |27E| ASSISTANCE BY SOIL CONSERVATION SERVICE: Enter N for None; T for Technical Assistance; F for Financial Assistance; B for Both Technical and Financial Assistance.
Item |27F| VERIFICATION: Date the data was verified as being complete and correct. Enter date as described in Item |12|.

LINE 4:

Item |28| REMARKS: Preface remarks with the item number to which it pertains, e.g., 22-ORIGINALLY CONSTRUCTED IN 1928, 23-SETTLING BASIN. Only one remark line should be used for PART I remarks.

①

PART III - INVENTORY OF DAMS IN THE UNITED STATES
SUPPLEMENTARY DATA

STATE	IDENTITY NUMBER
ME	00472

LOCATION (A)

	A-1 TOWN	A-2 NED PERMIT NO.	A-3 STATE NUMBER	A-4 F.E.R.C. NO.	A-5 U.S.G.S. SHEET
A	WATERVILLE				WATERVILLE, ME.

DRAINAGE CHARACTERISTICS (B)

	B-1 DRAINAGE AREA SQ MI	B-2 FLOW DATA MIN. C.F.S.	B-3 AVE. C.F.S.	B-4 MAX. C.F.S.	B-5 CREST ELEV. M.S.L.	B-6 ABUT. ELEV. M.S.L.	B-7 USABLE STORAGE ACRE FEET	B-8 RESERVOIR AREA ACRES	B-9 FLASH BOARD HT. FEET	B-10 OUTLET CONDUITS NO.	B-11 SIZE	B-12 INVERT ELEV. M.S.L.
B	0.5						185	11		3	20, 24, 14	

POWER DATA (C)

	C-1 GENERATION UNITS INSTALLED NO.	CAP K.W.	C-2 PLANNED NO.	CAP. K.W.	C-3 AVERAGE ANNUAL GENERATION K.W.H.	C-4 LAST GEN YEAR	C-5 RETIRED YEAR	C-6 FORMER USE	C-7 CAPACITY FACTOR
C	0		0						

D	
E	

NED FORM 80 (TEST)

PART II – INVENTORY OF DAMS IN THE UNITED STATES
(PURSUANT TO PUBLIC LAW 92–367)

See reverse side for instructions.

FORM APPROVED
OMB NO. 49–R0421

REQUIREMENTS CONTROL SYMBOL
DAEN–CWE–17

[1] STATE (1–2)	IDENTITY NUMBER (3–7)
ME	00472

STATISTICS

[29] D/S HAZ	[30] CREST LENGTH (ft)	[31] SPILLWAY TYPE	[32] SPILLWAY WIDTH (ft)	[33] SPILLWAY MAXIMUM DISCHARGE (cfs)	[34] VOLUME OF DAM (CY)	[35] POWER CAPACITY INSTALLED (MW)	[36] POWER CAPACITY PROPOSED (MW)	[37] NAVIGATION LOCKS NO.	[38] LENGTH (ft)	[39] WIDTH (ft)	[40] LENGTH (ft)	[41] WIDTH (ft)	[42] LENGTH (ft)	[43] WIDTH (ft)	[44] LENGTH (ft)	[45] WIDTH (ft)	BLANK	Card
3	780	N			6000													5

MISC. DATA

[46] OWNER	[47] ENGINEERING BY	[48] CONSTRUCTION BY	Card
KENNEBEC WATER DISTRICT	UNKNOWN	UNKNOWN	6

MISC. DATA *(Continued)*

REGULATORY AGENCY [49] DESIGN	[50] CONSTRUCTION	[51] OPERATION	[52] MAINTENANCE	Card
NONE	NONE	NONE	NONE	7

MISC. DATA *(Continued)*

[53] INSPECTION BY	[54] INSPECTION DATE (DAY / MO / YR)	[55] AUTHORITY FOR INSPECTION	Card
NONE			8

REMARKS

[56] REMARKS	Card
34-ESTIMATE	9

ENG FORM 1 DEC 77 4474A

PART II:

Item 1 IDENTITY: Enter Identity per GENERAL INSTRUCTIONS on PART I.

LINE 5:

Item [29] D/S HAZ: Enter the digit that most closely represents the hazard potential that could occur to the downstream (D/S) area resulting from failure or mis-operation of the dam or facilities.

HAZARD POTENTIAL

CATEGORY	LOSS OF LIFE (Extent of Development)	ECONOMIC LOSS (Extent of Development)
3 = Low	None expected (No permanent structures for human habitation)	Minimal (Undeveloped to occasional structures or agriculture)
2 = Significant	Few (No urban developments and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
1 = High	More than few	Excessive (Extensive community, industry or agriculture)

Item [30] CREST LENGTH: Enter, to the nearest foot, the crest length of the dam which is defined as; the total horizontal distance measured along the axis at the elevation of the top of dam between abutments or ends of dam. Note that this includes spillway width, powerhouse sections, and navigation locks where they form a continuous part of the dam water retaining structure. Detached spillways, locks, and powerhouses shall not be included.

Spillway:

Item [31] TYPE: Enter the one letter code that applies.

CONTROLLED = C UNCONTROLLED = U NONE = N

Item [32] WIDTH: Enter to the nearest foot, the width of the spillway available for discharge when the reservoir is at its maximum designed water surface elevation.
Item [33] MAXIMUM DISCHARGE: Enter the number of cubic feet per second which the spillway is capable of discharging when the reservoir is at its maximum designed water surface elevation.

Volume of Dam:

Item [34] VOLUME OF DAM: Enter the total number of cubic yards occupied by the materials used in the dam structure. If volume of separate materials is known, enter in remarks. Include portions of powerhouses, locks and spillways only if integral with the dam and required for structural stability.

Power Capacity:

Item [35] INSTALLED: Enter installed capacity to one tenth (1/10) Megawatt as of the report date.
Item [36] PROPOSED: Enter the future additional capacity proposed to one tenth (1/10) Megawatt.

Navigation Locks:

Item [37] NUMBER: Enter the number of existing navigation locks for the project.

Item [38] LENGTH: Enter to the nearest foot the length of the navigation lock.

Item [39] WIDTH: Enter to the nearest foot the width of the navigation lock.

Item [40] thru [45] Enter the lengths and widths of additional locks.

LINE 6:

Item [46] OWNER: Enter name of owner. Abbreviate as necessary.
Item [47] ENGINEERING BY: Enter name of organization that engineered the main dam structure. Abbreviate as required.
Item [48] CONSTRUCTION BY: Enter name of construction agency responsible for construction of main structure. Abbreviate as required.

LINE 7:

Regulatory Agency:

Item [49] DESIGN: Enter the name of the organization other than the owner having regulatory or approval authority over the design of the dam. If no organization other than the owner has regulatory or approval authority over the design of the dam indicate NONE.
Item [50] CONSTRUCTION: Enter the name of the organization other than the owner having regulatory authority or inspection responsibilities over the construction of the dam. If no organization other than the owner has regulatory authority or inspection responsibilities over the construction of the dam indicate NONE.
Item [51] OPERATION: Enter the name of the organization other than the owner having regulatory authority, operational control, or surveillance responsibilities over the operation of the dam. If no organization other than the owner has regulatory authority, operational control or surveillance responsibilities over the operation of the dam indicate NONE.
Item [52] MAINTENANCE: Enter the name of the organization other than the owner having regulatory authority or inspection or surveillance responsibilities over the maintenance of the dam. If no organization other than the owner has regulatory authority or inspection or surveillance responsibilities over the maintenance of the dam indicate NONE.

LINE 8:

Inspection:

Item [53] BY: Enter the name of the organization that performed the last safety inspection. Abbreviate as required. If no inspection has been performed enter NONE.
Item [54] DATE: Enter the one (1) or two (2) digits for day, the first three (3) letters of the month and a two (2) digit year when the inspection was performed. If not applicable, leave blank.
Item [55] AUTHORITY FOR INSPECTION: Enter the legislative or regulatory authority for performing the inspection indicated in item 53, e.g., P.L. 92-367; Div 3, Water Code, State of Calif; ER 1110-2-100; etc.

LINE 9:

Item [56] REMARKS: Preface remarks with the item number to which it pertains. e.g., 34.2, 500,000 c.y. conc. 475,000 c.y. earthfill. Only one Remarks line should be used for PART II remarks.